

## IX. ON VARIOUS SOUTH AMERICAN PÆCILIID FISHES.

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(PLATES XVIII-XXI.)

### INTRODUCTORY.

The present account is largely based upon collections made from 1907 until 1910, by Mr. John D. Haseman in central South America, during the expedition of the Carnegie Museum. An account of this expedition with a list of the localities, where Mr. Haseman made collections, was published in these ANNALS, Volume VII, pp. 288-314. A review of the specimens obtained by Professor C. H. Eigenmann during a reconnaissance of the basins of the Magdalena, Cauca, Dagua, San Juan, and Atrato Rivers of Colombia is included. This expedition was under the auspices of the Indiana University and the Carnegie Museum.

Besides this material I have examined and included a list of the specimens obtained in 1913, by Mr. Charles E. Wilson when on the Landon-Fisher Expedition of Indiana University to western Colombia, and those secured by the writer in southwestern Colombia and Ecuador in 1913 and 1914 during the Landon Expedition of Indiana University. A review of the last three expeditions appeared in *Science* for 1914, pp. 602-606.

The numbers, unless otherwise stated, are the catalog numbers of the Carnegie Museum and the Indiana University. A full series of the fishes obtained by the Indiana University Expeditions is included in the collections of the Carnegie Museum. I have had constantly at hand for reference the collections in the Museum of Indiana University, where this paper was prepared.

For the species mentioned I have given in most cases the synonymy and bibliography subsequent to the publication of Garman's monograph of this family: "The Cyprinodonts," Mem. Mus. Comp. Zool., Vol. XIX, No. 1, 1895. In a few cases, where the synonymy in that work was inaccurate or obscure, I have given the complete synonymy since the earliest reference to the species.

<sup>1</sup> Contributions from the Zoölogical Laboratory of Indiana University, No. 125.

The genera defined or accepted in this paper are largely based upon the variously arranged hooks and barbs at the tip of the modified anal fin of the male and the arrangement and shape of the teeth. Dr. Eigenmann (1907, p. 425) first used the former characters in defining genera of Pœciliids. He examined microscopically the anals of a number of species, and among others based the genera *Phalloceros* and *Phalloptychus* on these characters. The study of the anal has been greatly extended in a recent paper by Mr. C. T. Regan (c. 1913),<sup>2</sup> who revised all of the Pœciliinæ. The examination of the anal is somewhat tedious. The anal of the male must be mounted in damar, or balsam, and studied with a compound microscope. Unquestionably, however, such procedure demonstrates true relationships, and no new species should be described without an examination of the anal. These characters are small since the males of these fishes are among the least of vertebrates. Were these fishes larger in size and easily examined, these characters would long ago have been used in generic descriptions. It will be unfortunate, however, if this system should lead to needless multiplication of genera. Some of the closely related genera already recognized by Regan should probably be united.

Within recent years these little fishes on account of their bright colors and interesting habits have been extensively introduced as aquarium fishes, especially into Germany. Various popular accounts have appeared in some of the fanciers' journals, such as the "Wochenschrift Aquarien-Terrarienkunde" and the "Blätter Aquarien-Terrarienkunde." These have not been accessible to me. In a contribution from the Zoölogical Institute of the University of Berlin, Erich Philippi, (d. 1908) has reviewed the more significant of these notices and has added extensive observations of his own. Of this very thorough paper I have given considerable summaries in English, particularly of the parts dealing with the breeding habits. Philippi reared and observed in the aquarium two species, *Phalloceros caudomaculatus* and *Cnesterodon decem-maculatus*. In his account the former is constantly spoken of as *Glaridichthys* (*Phalloptychus*) *januarius*. But he did not have and did not know *P. januarius*, and his systematic deductions are therefore quite in error.

In a number of instances observations, especially in regard to the development and differentiation with age, number of young, etc., are

<sup>2</sup> The reference is to the bibliography of the subject which is given on p. 107.

my own. For such studies I have had at command more than two thousand of *Lebistes reticulatus* and more than eight hundred specimens of *Pseudopæcilia fria*, representing all sizes and conditions, as well as large numbers of other species.

This paper was prepared at Indiana University under the supervision of Professor C. H. Eigenmann, to whom I am under obligations for having given me the opportunity to make these studies, and who aided me by giving me access to the literature, and making valuable critical suggestions. To Dr. W. J. Holland I am indebted for the editorial revision of the manuscript and the reading of the proofs while going through the press.

#### NEW GENERA AND SPECIES.

The following new species and genera are described by the author:

- Rivulus compressus* sp. nov.,
- Diphyacantha chocoënsis* gen. et sp. nov.,
- Heterandria hasemani* sp. nov.,
- Neoheterandria elegans* gen. et sp. nov.,
- Phalloptychus eigenmanni* sp. nov.,
- Phallotorynus fasciolatus* gen. et sp. nov.,
- Limia hollandi* sp. nov.

The following species, considered to be new, are jointly described by Eigenmann and Henn:

- Rivulus magdalencæ* sp. nov.,
- Gambusia caliensis* sp. nov.

#### THE PÆCILIIDÆ.

The Pæciliidæ, or Cyprinodontidæ,<sup>3</sup> were long placed in the heterogeneous assemblage of the order Haplomi. Regan (a, 1911) has lately investigated their structure and placed them along with the blind fishes (Amblyopsidæ) in a new order, the Microcyprini. This he divides into the suborders Amblyopsoidea and Pæcilioidea. The principal differences between the Haplomi and the Microcyprini are given in the following extract: "The Haplomi are physostomous, the maxillary enters the gape, the mesethmoid is represented by a pair of dermal bones, and the ribs are borne on autogenous parapophyses. The Microcyprini appear to be physoclistic, the mouth is bordered

<sup>3</sup> Gill (1894, p. 115) gives the reasons for preferring the name Pæciliidæ. .

above by the premaxillaries only, the mesethmoid is unpaired, and all or most of the ribs are inserted on strong transverse processes. Whereas the Haplomi show relationship to the more generalized isospondylous fishes, the Microcyprini bear more resemblance to the Salmonperceæ and Synentognathi, especially the latter."

In the Oligocene and Miocene of Europe occur the fossil remains of *Prolebias*, a generalized form, related to the recent genus *Fundulus*. From this central type adaptive radiation has taken place, resulting in considerable modification of the form of the body and structure. Differences in the character of the teeth and the length of the alimentary tract have arisen in the same subfamily through adaptation to a carnivorous or a vegetable diet. In some cases evolution in one species has paralleled that in another, unrelated species. For instance, the ventrals have been lost in *Orestius* and *Empetrichthys*.

The family consists of oviparous forms, in which the eggs are deposited in the usual manner, and viviparous forms, in which the ova undergo development within the ovarian sack and the young are born in a more or less advanced stage of development. The oviparous species are contained in three sub-families, the Cyprinodontinæ, Orestiinæ, and Fundulinæ, in which the sexes do not greatly differ from each other.

Of viviparous forms there are five subfamilies. In these fertilization of the female is effected, with but one exception, with the aid of the anal fin, which is modified to serve as a so-called intromittent organ. In the *Fitzroyiina* or *Jenynsiina*, and the *Anablepina*, both of which are monogeneric and contain but few species, the anal rays are rolled up into a tube. The *Characodontina* resemble the oviparous *Fundulina* in appearance, but the male has the first five or six rays of the anal short and stiff and separated by a notch from the rest of the fin. This subfamily, with the exception of a few species, is found only in the basin of the Rio Lerma of Mexico. This type of anal structure is much more simple than that in the *Pæciliina*, in which the anterior rays are thickened and lengthened to form a lever.

The viviparous forms were thought to be entirely confined to the western hemisphere. Quite recently Regan (*b.* 1913) has described *Phallostethus dunckeri*, a remarkable new Pæciliid and the type of a new subfamily. This fish, which is from Johore on the Malay Peninsula, is viviparous. While in all the other viviparous forms, which



are limited to the Americas, it is the anal fin which serves as the intromittent organ, it seems that in males of this species the ventral fins have become modified into a large muscular appendage, or intromittent organ. This might indicate that viviparity in this subfamily may be of independent origin.

#### POSTNATAL DEVELOPMENT IN THE SUBFAMILY PÆCILIINÆ.

In most of the viviparous forms the sexes at birth are indistinguishable. The anal fin of the male occupies the same position as that of the female, its shape is the same, and the individual rays are clearly apparent. The location is usually below the posterior part of the dorsal fin. As development proceeds, the third, fourth, and fifth rays become lengthened, although they still remain separate and distinct for some time. Eventually these attain their full length and appear to be fused. While distinct, they are closely apposed and form a stiffened rod or lever. The length varies with the different genera; usually it is about one-third of the whole length of the fish. The tip of this intromittent organ is provided with hooks and spines, the arrangement of which differs in the various genera.

While these modifications have been taking place, the whole fin has been gradually moving forward, so that, when development is complete, the position of the fin has changed from abdominal to thoracic. The external openings of the genital tract, the ureter and the intestine, which lie just before the anal, have also moved with it. This migration of the vent is evidently similar to that which takes place in the blind-fish (*Amblyopsis spelæus*), where the opening of the oviduct along with that of the intestine and the ureter move forward, so that the eggs may pass into the gill-chamber, where they are incubated. The ventral fins also travel forward, and the final position of these and of the anal is close up under the pectorals.

A support, which is necessary for the mass of muscles involved in the complicated movements of the anal fin during copulation, is provided in the males through a modification of the posterior præcaudal vertebræ. A process or stay extends forward from each of the arches uniting the parapophyses of the last few præcaudal or rib-bearing vertebræ. In the vertebræ thus modified the ribs are absent, but their places are taken by short processes which project backward in the median line. The number of vertebræ bearing these stays varies greatly. In *Pæcilia vivipara* (Fig. 1) there are only two; in some forms

there are as many as five. In *Cnesterodon* there are none. In *Phallotorynus* there are three, the first and last are long and needle-like and the central one is expanded or club-shaped at the tip. Just before these there is a single short stay. Garman (*b*, Plate VIII) has figured many of the different species. The muscular mass enveloping the base of the anal is directly attached by a tough ligament to the vertebral column.

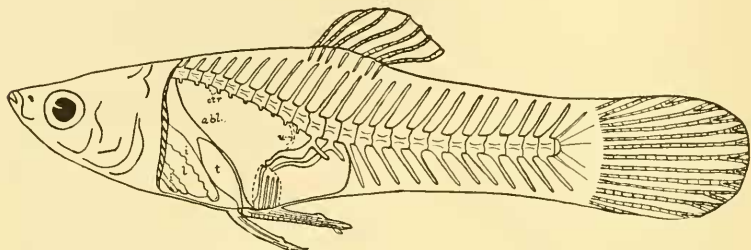


FIG. 1. Diagrammatic sketch of *Pæcilia vivipara*, ♂, showing modification of last two precaudal vertebrae to form a support for the intromittent organ. *i*, intestine; *l*, liver; *t*, testicle; *abl*, air-bladder; *u*, ureter; *ctr*, ends of ribs cut off to show abdominal cavity.

For the modified subvertebral processes Philippi (*d*, 1908) has proposed the term 'gonapophysis.' In *Pæcilia vivipara* (Fig. 1) the first of these processes joins directly with the enlarged first interhæmal. The other interhæmals or *radialia*, with which the rays of the anal fin are articulated, are sharp and slender, and all, including the first enlarged one, are enclosed in the mass of muscles, which controls the movements of the fin.

The forward position of the anal fin in the male causes the crowding of the viscera into the extreme forward end of the body-cavity. In females the development of young within the ovarian sack likewise causes a pushing of the viscera toward the head. In this sex the air bladder is a simple oval sack, but in males the development of the subvertebral stays causes a split in the organ, so that posteriorly it is bilobed, with the subvertebral processes occupying a position between the lobes.

#### BREEDING HABITS.

The act of copulation in the viviparous Pæciliids has not often been seen. Agassiz (1853, p. 135) witnessed it in *Mollienisia latipinna*, and in this manner learned that the two forms, which had previously

been considered members of different genera, were in reality male and female of the same species. He gave no details of the behavior of the two sexes.

Ryder (1885, p. 155) published a more detailed account of the actions of *Gambusia patruelis*, based on observations related to him by A. A. Duly, an employee of the National Museum. The head of the male was said to be turned in the direction of the tail of the female during coitus and the prolonged anal fin thrust into the external opening of the ovarian duct. This account, according to the observations of both Philippi and Seal, is entirely wrong.

Philippi had opportunity to see the copulation in both *P. caudomaculatus* and *C. decem-maculatus*. The habits of the two species are essentially alike. The anal fin of the male, which normally lies folded against the abdomen, is in breeding males suddenly thrust forward and somewhat sidewise. The male slowly follows the female, but maintains a certain distance, going through exactly the same motions as the female. In general the male swims somewhat under and behind the female. It suddenly darts upward toward the female, and with extraordinary speed places the tip of the anal bearing a sperm capsule upon the urogenital papilla of the female. With equal speed its course is continued and the anal is withdrawn into the usual position.

Seal (1911, p. 92) observed the breeding habits of *Gambusia holbrooki* and *Heterandria formosa*, which he kept in aquaria. The habits are said to be exactly alike. He says: "The male follows incessantly and warily after the female, on the left side and to the rear, the female frequently turning and making savage dives at him, causing him to turn and flee, but to return immediately and follow, watching for a moment when her attention will be distracted, when he will make a sudden dash, sometimes succeeding in inserting the intromittent organ into the genital pore, but oftener apparently missing, because of a quick turn of the female from which he flees in apparent terror. The contact is so sudden and brief that it required many observations to verify it. In these movements the male organ is thrust forward and to the right toward the female. In small jars the males are frequently killed, especially when the female is full sized, or if there are two or three females to one male. . . . There is never more than one male following a female. If others approach, the male turns and drives them off."

These accounts are in almost entire accord and are the most complete yet given. The manner of conducting the spermatozoa from the genital opening to the tip of the anal, however, is yet to be made known. In most of the viviparous forms, except *Fitzroyia* and *Anableps*, the genital duct of the male opens immediately in front of the base of the anal fin. In certain genera, such as *Pæcilia*, *Mollienisia*, *Limia*, and *Xiphophorus*, the ventral fins, which adjoin the anal, are elongated, and, if pressed against it, would form a tube extending nearly to the end of the anal, through which the spermatozoa might pass. In the majority of the viviparous genera, however, such as *Heterandria*, *Phalloceros*, and *Cnesterodon*, the ventral fins are altogether too small to be of such service. Further observations on living fishes will be necessary to determine the manner in which the sperm bodies are transferred to the tip of the anal. In *Fitzroyia* and *Anableps* the ureter and the sperm-duct continue to the end of the anal, which in this case is an actual tube.

Garman (*a*, p. 1012) observed that in *Anableps* the tip of the tubular anal of the male is invariably pointed either to the right or to the left. In females the genital orifice is protected by a large scale, which is fastened either on one side or the other, and permits the entrance of the anal of the male only from the opposite side. This Garman fancifully thought was a unique device to insure cross-fertilization. It is obvious that a male with the tip of the anal directed toward the *right* can mate only with a female having the *left* side of the genital orifice free through the fastening of the protective scale upon the right side. Garman thought that in the same brood probably all males and all females were of the same type of structure and that interbreeding would thus be prevented. In *Fitzroyia* the anal of the male is also tube-like and the direction of its tip is fixed. But since in this genus the genital orifice of the female is unprotected by a scale or otherwise, it seems probable that mating can be accomplished by either type of male with any female. There would thus be no provision to insure cross-fertilization in this genus.

Philippi observed that, although both sides of the anal are alike in *P. caudomaculatus* and *C. decem-maculatus*, the anal can in any one individual be used only on one side of the body. In *P. caudomaculatus* it is prevailing the left side, and in *C. decem-maculatus* the right, from which the anal may be thrust out. This it is presumed means that males of *C. decem-maculatus* approach the female from the left side,

and of *P. caudomaculatus* from the right. A variant is sometimes found which moves the anal on the side of the body opposite that which is characteristic of the species.

The males of *P. caudomaculatus* and *C. decem-maculatus* are, according to Philippi, sexually active throughout the year. In the aquarium they follow other specimens about continually, even though these are immature individuals of either sex. That this is not due to playful instincts, or to similar reasons, is shown by the constant folding and unfolding of the anal and the restless swimming up to the other fishes from below and behind, which are characteristic actions of breeding males. Females however show a definite rest-period, which in Berlin happens during the winter. At this time one of the females under observation sank to the bottom of the basin, where it remained surrounded by the waiting males, but free from their attacks, since these must rise upward from below in order to effect a transfer of the sperm.

#### AGGREGATIONS OF SPERM, OR "SPERMOZEUGMATA."

A slight pressure upon the abdominal wall of narcotized male fishes causes expulsion of the sexual products (Philippi). These consist of numerous milk-white bodies, which stick fast to the first available object. These collections of sperm are elliptical in shape and measure in *P. caudomaculatus* 122 microns in length and 73 microns in width; in *C. decem-maculatus* they are 220 microns long and 107 microns wide.

By fixation and staining with hæmatoxylin-eosin they are seen to consist of closely crowded spermatozoa, the long axes of which are perpendicular to the surface of the body. The heads of the spermatozoa lie at the periphery, while the center is composed of the tails and a few heads of spermatozoa. The whole mass is held together by a sticky substance, which is acquired in the lumen of the testicle. This sticky material probably causes the sperm-body to fasten to the genital papilla of the female. The entire outer portion of the genital tract of the breeding male is filled with these elliptical capsules. For similar aggregations of sperm in insects, which likewise lack an external investment, Ballowitz (1895, p. 458) has proposed the name "*spermozeugma*," plural "*spermozeugmata*."

Although the spermatozoa are ejaculated in the masses called spermozeugmata, the latter are never found in the oviduct. A number of these sperm-masses, immediately after being taken from the male,

were placed in normal salt solution, where they sank to the bottom. After eighteen hours the majority were unchanged; one had released a wisp of sperm, which remained about the otherwise unchanged mass, some showed softening, but very few had broken up. The following day the great majority were still unchanged, although somewhat swollen, and on the fourth day they still remained unchanged.

A number of these sperm-bodies were placed in a dish in which the ovary and genital tract of a freshly killed female had been crushed. Within a very short time (six minutes) after coming under the influence of the ovarian fluid these bodies had dissolved and the individual spermatozoa were set free.

A *receptaculum seminis* is formed by numerous unsymmetrical folds in the lining of the oviduct. Within these folds the spermatozoa are found in incredible numbers, and they remain here even after the birth of the young.

#### SUBSEQUENT FERTILIZATION FROM A SINGLE MATING.

Zolotnisky (1901, p. 65) observed that a female of *P. caudomaculatus*, which had been separated from males after the appearance of a brood of young, produced another within six weeks, and a third brood four weeks after this. This occurred, although copulation subsequent to the first parturition had not taken place. Philippi also isolated females at, or slightly before, parturition. In every instance the females became pregnant for a second time, and one specimen produced a third brood forty-six days after the appearance of the second. Poey noted these facts many years ago.

Many notices of "hybrids" among the viviparous species have appeared in the literature of fish-fanciers. These presumable hybrids have certainly arisen through the ability of bringing forth young without fertilization between broods. A female of one species, for example, which has borne young is placed with a male of another species. After some weeks young appear, which are taken for hybrids, but are in reality a product of the first mating. Actual hybrids can be obtained only by carefully rearing young fishes until discrimination of the sexes is possible. After this they must be kept rigidly separated, and the first mating of the young female must be made with a male of a different species. Unless this method has been practised, accounts of "hybrids" among these fishes are worthless.



## BIRTH.

In the two species, which Philippi had under observation, the young were born singly and at intervals of a few minutes. Delivery usually took place before eight o'clock in the morning, but in a few instances it took place about noon. During this period the female, when not tormented by males, remained just below the surface of the water. The young are not expelled in a definite position; either the head or the tail may appear first, and occasionally the young is expelled doubled upon itself. Delivery is much slower when the young appear tail first. In this case the adult may swim about for awhile with the half-protruding young. The position of the young in the ovary, as shown by cross-sections, is likewise undetermined.

Contrary to Ryder's statement that fright seemed to hasten parturition, Philippi found that excitement tended to greatly retard or postpone delivery. For better observation he placed females in the act of delivery in smaller aquaria. This usually caused a delay of four or five hours, and when parturition was resumed a number of unripe eggs were also cast out.

The cannibalistic habits of the fishes are pronounced, and when the birth is at an end the adult will seize upon her own young. This takes place even when the tank is well supplied with food. The males likewise devour the young fishes, and if they are to be reared, they must be separated from the adults.

Seal (1911, p. 93) states that the young of *Gambusia holbrooki* and *Heterandria formosa* are born one at a time. The ejection of each fish is so rapid that they appear as though shot out with some force. "This, however, might be due to the bursting of the follicle and the uncoiling of the fish as it is released from restraint. When they first appear they are still in a somewhat curved form, but they quickly straighten out and swim into hiding. . . . The intervals between the extrusions vary from several minutes to as many hours." Seal also noted the presence of two or more generations in a single season; fishes born early in May were themselves mature and producing young by the middle of August.

## NUMBER OF YOUNG IN SOME VIVIPAROUS SPECIES.

The number of young at birth in a given species is evidently quite variable. The appended table gives the number of embryos found in


females of various species. The ovaries have been dissected out and the number of young ascertained by carefully picking the ovary to pieces. In pregnancy the abdomen is greatly distended and the ovary fills a large part of the body-cavity. The ovary is exceedingly thin-walled, and as suggested by Ryder, the gravid follicles are hung together very much in the manner of a bunch of grapes. They are readily separable.

Species.	Size.	Date.	Locality.	Contents of ovary.
<i>P. vivipara</i> .....	55 mm.	April 14, 1908	Cachoeira, Bahia	34 small ova.
" "	71 mm.	" "	" "	111 small embryos, 3 small ova
" "	61 mm.	" "	" "	66 embryos, 2 ova.
" "	44 mm.	June 18, 1908	Munez Friere	32 ova.
" "	45 mm.	" "	" "	21 small embryos
<i>P. fria</i> .....	23 mm.	Aug. 11, 1913	Vinces, Ecuador	2 large embryos, 2 ova.
" "	27 mm.	" "	" "	4 large embryos, 6 small embryos, 3 ova.
" "	22 mm.	" "	" "	2 very large embryos, 1 small embryo.
" "	23 mm.	" "	" "	1 very large embryo, 1 small embryo, 3 ova.
" "	24 mm.	" "	" "	1 large embryo, 2 small embryos, 2 eggs.
<i>D. chocoënsis</i> .....	34 mm.	May 9, 1913	Chocó, Colombia	5 embryos, 8 ova.
<i>P. caudomaculatus</i> ..	55 mm.	July 26, 1908	Raiz da Serra São Paulo	39 embryos
" "	45 mm.	July 26, 1908	Raiz da Serra	25 ova.
" "	42 mm.	July 25, 1908	Alto da Serra	Spent.
" "	38 mm.	July 25, 1908	Alto da Serra	15 small ova.
<i>C. decemmaculatus</i> ..	38 mm.	Dec. 22, 1908	Serrinha Paran�, Rio Iguassu	16 embryos.
" "	45 mm.	Dec. 22, 1908	Serrinha Paran�,	55 embryos.
" "	39 mm.	Dec. 22, 1908	Serrinha Paran�,	28 embryos.
" "	40 mm.	Dec. 22, 1908	Serrinha Paran�,	20 embryos.
" "	36 mm.	Dec. 22, 1908	Serrinha Paran�,	31 embryos.
<i>Limia hollandi</i> .....	42 mm.	July 31, 1908	Rio Pil�o, S. Paulo,	24 embryos.

The ova are quite large, yellowish in appearance, and spherical, measuring on an average 1.5 mm. in diameter. In this list I have counted as ova those which show no differentiation. When development begins the optic vesicles early become pigmented, and are the first major indication of the initiation of development. Examination with a binocular microscope is sufficient to distinguish a small embryo from an undifferentiated egg.

It will be seen that the same females often contain both large and small embryos and undifferentiated ova. The latter are often quite small and the birth of the young which they are to produce will be postponed considerably after the birth of the larger ones. Specimens of *Diphyacantha chocoënsis*, which externally seemed pregnant and had evidently just been delivered of one brood, judging from the collapsed ovaries, still contained a few small embryos and ova. Similar conditions were found in specimens of *Pseudopæcilia fria*. These observations are to be correlated with the observations of Philippi, who noted successive births from a single mating. In other specimens it is common to find a few embryos considerably behind in development, when compared with the average. These probably are the result of later fertilization. The period in which delivery takes place is also variable, since in the same locality specimens are found with the contents of the ovary ranging in different examples all the way from small ova to embryos nearly ready for birth. Usually, when taken during the breeding season, all of the mature females from a given locality are pregnant. Occasionally, however, fully mature individuals contain neither ova nor embryos.

The presence in the ovary at the same time of both ova and embryos in one or two different stages of development seems to have previously been noticed by only one observer. E. G. Boulenger (1912, p. 906) remarked these facts in *Lebistes reticulatus*, but there is no indication that his observations were based on actual dissection of the ovary. He says, "As breeding goes on all through the year, at least in captivity, the female is in an almost permanently pregnant condition, and within a fortnight of having brought forth a brood (such a period representing the duration of the gestation, at a temperature of over 70°) once more brings a generation into the world. It should be borne in mind, however, that a single impregnation is sufficient for the fertilization of several broods, the embryos of the second and third generation being already in an advanced condition when the first young are born."



## THE SEX RATIO.

The general predominance of females in collections of viviparous Pœciliids has been repeatedly noticed by students of these fishes. The bright colors of the males and structure of the anal fin make the discrimination of the sexes in mature examples an easy matter. Garman (1895, p. 7), after observation of numbers of specimens, was impelled to say, "By common experience collectors find males to be less numerous than females. The striking appearance of the male will no doubt be claimed as evidence of selection, because of a possible benefit in enabling the female more readily to find him; it may also be utilized in explaining the discrepancy in numbers, since it must be effectual in making him an object of more prominence and a more frequent prey than the other sex for enemies of the species."

Most writers are inclined to attribute the discrepancy in numbers of the two sexes to the much smaller size of the male, which causes it to be overlooked by collectors and also enables it to escape through the meshes of seines, which readily hold the bulkier females. From a study of the Haseman collections I observed that in nearly every species the number of females is more than double that of the males.

I have carefully examined all of the specimens in a pint of *Lebistes reticulatus* taken under Dr. Eigenmann's direction in the Barbadoes. This collection was taken with a very finely meshed net and represents the conditions actually found in nature, since it includes specimens of minute water-insects, plant-rootlets, and other things. Many fishes, not larger than five millimeters, have been included and it is quite evident that few went through the seine. This lot comprises 2,070 specimens, of which 520 are males, 630 are females, and 920 are too small to be determined. The latter average about eight or ten millimeters; when that stage has been passed it becomes easier to distinguish the sexes. Males then exhibit the characteristic markings, the anal fin becomes advanced and modified, and full maturity is reached when the male is about fifteen millimeters in length. Females are much larger and may reach a length of from twenty-five to thirty millimeters. It is quite certain that this count of males includes only members of that sex, while a few of the smaller specimens regarded as females may really have been immature males. It will thus be seen that the sex ratio, when an adequate collection is at hand, does not materially differ from that found in other fishes. Mr. Edward

G. Boulenger (1912, p. 906), who has reared this species, likewise notes the equality of sexes in very small broods; a fact, however, which in the prevailing idea of the numerical inequality of the sexes he considers remarkable.

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## GENERA AND SPECIES OF PÆCILIIDÆ.

## Genus RIVULUS Poey.

*Rivulus* POEY, Memorias sobre la Historia Natural de Cuba, II, 1858, 307, 383; GARMAN, Mem. Mus. Comp. Zoöl., XIX, 1, 1905, p. 134; REGAN, Ann. Mag. Nat. Hist., (8), X, 1912, p. 495.

Type, *Rivulus cylindraceus* Poey.

Small, usually depressed, oviparous fishes, in which the margins of the eyes are not free and the gill-membranes are separate and free from the isthmus. Dorsal smaller than the anal and placed much farther back. The sexes do not differ, except that the female is generally brighter and usually has a caudal ocellus.

Teeth in each jaw, an outer series of sharp, recurved canines, with several rows of minute teeth behind them.

1. *Rivulus cylindraceus* Poey.

5812 a, C. M. 35 mm. Los Indios, Isle of Pines. Gustav Link.

2. *Rivulus hartii* (Boulenger).

*Haplochilus hartii* BOULENGER, Ann. Mag. Nat. Hist., (6), VI, 1890, p. 190; REGAN, Proc. Zoöl. Soc. London, 1906, I, p. 389, pl. XXI, fig. 2.

*Rivulus hartii* REGAN, Ann. Mag. Nat. Hist., (8), X, 1912, p. 501.

13608, I. U. M. Three, 25-46 mm. Quebrada Cramalote, Villavicencio, Colombia. Gonzales.

13609, I. U. M. Two, 23-47 mm. Barrigona, Rio Meta. Gonzales.

These specimens are provisionally placed here. D. 8-9; A. 12, 13, 14 and 15; lat. l. 38-40. They resemble *R. hartii*, but the caudal is rounded and without a black margin.

3. *Rivulus elegans* Steindachner.

*Rivulus elegans* STEINDACHNER, Denkschr. Akad. Wissen. Wien, XLII, 1880, p. 85, pl. VI, fig. 6; REGAN, Ann. Mag. Nat. Hist., (8), X, 1912, p. 498 (Rio Condoto, Colombia); *ibid.*, 1913, p. 471.

5810 a-d, C. M.; 13601 I. U. M. Twelve, 23-45 mm. Rio Condoto, Colombia. Wilson.

5811 a-i, C. M.; 13602 I. U. M. Twenty three, 17-31 mm. Rio Truando. Wilson.

Head 4-4.2; depth 5; depth of caudal peduncle 7.5-8 in length to base of caudal and 2 in head. Eye 3.5 in head and 1.5 in interorbital.



D.  $\frac{7}{13}$ ,  $\frac{8}{1}$ ; A.  $\frac{12}{3}$ ,  $\frac{13}{11}$ ,  $\frac{14}{1}$  (the denominator represents the number of individuals); scales 33-37 in a lateral series, 9 in transverse series.

Origin of dorsal over last three rays of anal, about twice as distant from the operculum as from the base of the caudal, its height equal to the length of the pectoral. Origin of anal slightly nearer operculum than base of caudal. Ventrals small, equidistant from tip of snout and base of caudal; their length equal to the diameter of the eye.

General coloration of males (specimens from Condoto) light olivaceous, center of each scale lighter, their edges forming longitudinal stripes, belly whitish. Top of head dusky, an oblong dark spot underlying the operculum. All fins dusky, unspotted; anal with a clear whitish border at the base, becoming darker outwardly, it and the lower caudal margin edged with deep black. In females the dark longitudinal stripes are broken by light patches, which form transverse oblong blotches. The dorsal and caudal fins are heavily spotted and the anal more lightly. In none of the specimens from the Rio Condoto is there a caudal ocellus. In the specimens from the Rio Truando almost half of the females possess a distinct caudal fleck and are much darker.

*Rivulus godmani* Regan, of which I have examined numerous specimens, recorded as *R. elegans* by Miller (*Bull. American Mus. Nat. Hist.*, Vol. XXIII, 1907, p. 104) from Los Amates, Guatemala, seems only to differ from *R. elegans* in having the dark edge of the lower caudal lobe of the males broadened to form an intramarginal stripe with a pale lower margin.

#### 4. *Rivulus magdalenæ* Eigenmann & Henn, sp. nov.

- 5813, C. M. Type, 56 mm. 5814 *a-m*, C. M.; 13603 I. U. M., twenty-five paratypes, 24-62 mm. Ibagué, (elevation 4,250 ft.). 5815 *a-h*, C. M.; 13604 I. U. M., fifteen, 20-45 mm., Rio Guaduas, Dept. of Cundinamarca. Gonzales.
- 5816 *a-b*, C. M.; 13605 I. U. M., four, 25-46 mm. Rio Villeta. Gonzales.
- 5817 *a-h*, C. M.; 13606 I. U. M., fifteen, 20-42 mm. Quebrada de Chamisal. Gonzales.
- 5818 *a-b*, C. M., two small specimens, 11-15 mm., probably belong here. Boquia. Eigenmann.

All of these localities except Boquia, which is in the Cauca basin west of the central Cordilleras, are in the highlands of the Magdalena Basin, west of Bogotá.

Very similar in proportions to *R. elegans*, differing in the smaller scales and in coloration.

Head 3.8-4; depth 5-5.2; caudal peduncle 7-8 in length and 2 in the head. Eye 3 in head; 1.5 in interorbital. D. 9-11; A. 15-16; scales 40-42 in lateral series, 9 in transverse series.

Origin of dorsal twice as distant from the point a snout-length behind the eye as from the base of the caudal, or about two head-lengths behind the operculum. Other fins as in *R. elegans*, except that the caudal is sub-truncate, not oval or rounded.

Olivaceous, streaked and blotched with dark brown. Dorsal and caudal streaked with the same color. Operculum underlaid with blackish. A series of heavy vertical purplish blotches in the mid-lateral line. Females have a circular caudal ocellus surrounded by a white margin. Males have the tip of the anal and both caudal edges margined with black.

##### 5. *Rivulus waimacui* Eigenmann.

Regan (Ann. Mag. Nat. Hist., (8), X, 1912, p. 497) regards *Rivulus waimacui* Eigenmann as synonymous with *R. holmie* Eigenmann. These species while similar are, however, distinct. The distinguishing characters are sufficiently indicated in the key accompanying the original descriptions while other points are:

- a. Origin of dorsal about two, or less than two and one-half, head-lengths behind the operculum; D. 8-9; A. 16; scales in lateral series forty-three or forty-four, with about three on the base of the caudal; a median predorsal series of about twenty-seven scales; this series is discontinued five or six scales before the dorsal, where those of the two sides dovetail or overlap the median line; females with a caudal ocellus.....*R. holmie*.
- aa. Origin of dorsal two and one-half, or more, head-lengths behind operculum; D. 8; A. 14; scales in lateral series forty-seven to fifty, with three or four on base of caudal; a regular median series of thirty-three to thirty-eight scales between occiput and dorsal; females without a caudal ocellus...*R. waimacui*.

##### 6. *Rivulus urophthalmus* Günther.

*Rivulus urophthalmus* GÜNTHER, Cat. Fishes, Brit. Mus., VI., 1866, p. 327; REGAN, Ann. Mag. Nat. Hist., (8), X, 1912, p. 498.

4631, C. M. Eight, 24-33 mm., Alagoinhas, Rio Catu, Bahia. Haseman.

4632, C. M. Ten, 23-43 mm. Raiz da Serra, São Paulo. Haseman.

4633, C. M. Six, 27-45 mm. Cubatão, Rio Cubatão, São Paulo. Haseman.

5821, C. M. Two, 52-56 mm., Iguape, Rio Ribeira da Iguape. Haseman.

7. *Rivulus obscurus* Garman.

*Rivulus obscurus* GARMAN, Mem. Mus. Comp. Zool., XIX, 1895, p. 140; PELLEGRIN, Bull. Mus. d'Hist. Nat. Paris, 1899, p. 157, (Rio Spuié); REGAN, Ann. Mag. Nat. Hist., (8), X, 1912, p. 502.

5820, C. M. Four specimens, 27-30 mm. Manáos. Haseman.

D. 5, A. 7, lat. l. 29 in 2 specimens; D. 5, A. 8, lat. l. 29 in another, and D. 6, A. 9, lat. l. 30 in the last. These agree in all respects with the original description, except that the dorsal is completely posterior to the anal.

8. *Rivulus punctatus* Boulenger.

*Rivulus punctatus* BOULENGER, Boll. Mus. Torino, X, No. 196, 1895, p. 3 (Colonia Riso); EIGENMANN, Proc. U. S. Nat. Mus., XXXII, 1907, p. 430; EIGENMANN, Repts. Princeton Univ. Exp. Patagonia, III, 1910, p. 454.

4625, C. M. Two, 16 and 22 mm. Villa Hays, Paraguay. Haseman.

4626, C. M. Nine, 14-30 mm., Urucum Mts., Corumbá, Matto Grosso. Haseman.

4627, C. M. One, 24 mm. Puerto Suarez, Bolivia. Haseman.

4628, C. M. One, 22 mm., Rio Santa Rita, into Rio Paraguay, Matto Grosso. Haseman.

With these is probably to be included, 4629, C. M., a specimen 22 mm. long from the Rio Boa Ventura, Matto Grosso of the Rio Guaporé.

These specimens agree very well with the description of Boulenger D. 5-6; A. 11; P. 10; V. 5; lat. l. 30-31; 9 transverse series of scales.

Head 4, depth at anal origin 7; caudal peduncle 10. Finely spotted; caudal with a number of cross-bars.

9. *Rivulus compressus* Henn, sp. nov. (Plate XVIII, fig. 1.)

5819, C. M. Type, unique, 55 mm. Manáos, Nov. 30, 1909. Haseman.

This may be *R. micropus* Steindachner, but it seems to differ in the more forward position of the dorsal, the longer head, etc.

Head 4; depth 5.2; caudal peduncle 8 in the length; 2 in head. Eye



3.5 in head, 1.5 in interorbital and equal to the snout. D. 7; A. 14; 42 scales in horizontal series, 8 between dorsal and anal.

Head broader than deep. Very much compressed posteriorly, greatly depressed anteriorly, width of fish at ventrals one-half its width at the occiput. Profile slightly arched, cleft of mouth horizontal.

Origin of dorsal three times as distant from the tip of the snout as from the base of the caudal, inserted over the last anal ray. Origin of anal equidistant from operculum and base of caudal, ventrals equidistant from tip of snout and base of caudal, one and one-half as long as eye.

Coloration olivaceous, a narrow brown stripe between the rows of scales. Top of head and dorsal ridge darker.

#### 10. *Rivulus brevis* Regan.

*Rivulus brevis* REGAN, Ann. Mag. Nat. Hist., (8), X, 1912, p. 504 (Colombia).

University of Michigan, ten specimens, 26-45 mm., from Fundación, near Santa Marta, Dept. of the Magdalena, Colombia.

Much deeper and more compressed than most of the species of this genus. Head deeper than broad in mature examples; in young, as broad as deep.

Head 3.3-3.5; depth at origin of ventrals 3.5-3.8; depth of caudal peduncle 5.5-6 in length and 1.6 in head. Eye 3 in head, slightly less than interorbital. Width of the head 1.5 in the depth, which is 1.5 in the length. D. 8-9; A. 12-13; scales 29-30 in a lateral series, 8 or 9 in transverse series.

Origin of dorsal twice as distant from the anterior margin of the orbit as from the base of the caudal. Dorsal rises over the middle of the anal. In adult specimens the rays of all the fins are prolonged. The eighth to the eleventh rays of the anal are extended to form a streamer, which reaches to the base of the lower caudal fulcrum. Dorsal rays also prolonged. Middle rays of pectoral prolonged and reaching almost to middle of ventrals, which are extended on to the base of the anal. Caudal rays elongated, lowest rays often forming a streamer, basal third with a heavy sheath of small scales. All fins blackish.

#### Genus *GAMBUSIA* Poey.

*Gambusia* POEY, Memorias de Cuba, I, 1855, p. 382; Regan, Proc. Zool. Soc. London, 1913, p. 981.

11. *Gambusia caliensis* Eigenmann & Henn, sp. nov.

6700 a, C. M. Type, ♀, 34 mm., length to base of caudal 28 mm.  
Cali, Colombia. Eigenmann.

6700 b, C. M. An immature specimen, 16 mm. From the same locality.

In the absence of adult males the generic affinities of this species are, of course, uncertain. It has the mouth and dentition of *Gambusia*.

Head 4.6; equal to the depth at the origin of the anal; depth of caudal peduncle 7 in the length. Eye 3 in head; 1.5 in interorbital; snout 1.5 in eye. D. 9; A. 10; P. 10; V. 6; 30 scales in a lateral series with 2 on the base of the caudal; 7 in transverse series. There is a median predorsal series of twelve scales; this series ceases within four scales of the dorsal, where the rows of scales of the sides overlap. Dorsal profile rising or curved to the middle of the total length, then dipping to the dorsal; ventral profile much less curved.

Origin of dorsal equidistant from the tip of the caudal and the posterior margin of the orbit, or 1.6 times as distant from the anterior margin of the orbit as from the base of the caudal. Dorsal inserted over the last ray of the anal. Origin of anal about equidistant from base of caudal and posterior margin of orbit.

General coloration olivaceous, top of head and operculum darker. Outlines of scales broadly margined with chromatophores. A faint series of dusky, transverse bars. In the type, a pregnant female, the abdomen is distended and underlaid with purplish black.

Genus *DIPHYACANTHA*<sup>4</sup> Henn, gen. nov.

Teeth, very similar to those of *Gambusia*, *i. e.*, an outer widely spaced series of conical teeth; in immediate conjunction an inner series of small, closely set, similar teeth.

Anal in the males an elongate organ, equal in length to one-third of the total length of the fish. The terminal portion of this intermittent organ resembles that of *Pæcilia* and *Pseudopæcilia*; it differs from these and other genera in the character of the first prolonged ray, which lacks a prepuce, bears both dorsally and ventrally a subterminal series of retrorse hooks, and terminates in a single appendage or finger-like process. This, while much smaller, is median and unpaired, as in *Cnesterodon*.

<sup>4</sup> διφύης = twofold; ἀκανθα, ἦ = a spine, with reference to the bipartite structure of the hooked segments in the first prolonged ray of the male anal.

In females the ventrals are normal in shape and barely reach the vent. In males the ventrals, although proportionately of the same size, are slightly more lanceolate and are set more closely to the anal, which they overlap for a third of their length.

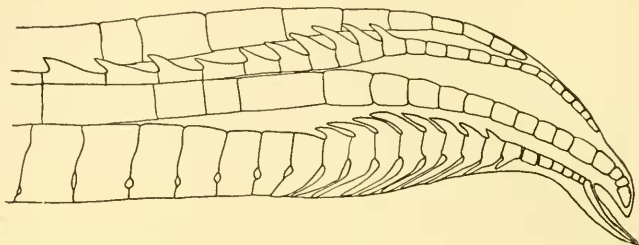


FIG. 2. *Diphyacantha chocoënsis* Henn. Distal end of intromittent organ.  $\times \frac{40}{1}$ .  
No. 13,620, I. U. M. Rio Calima, Colombia.

12. ***Diphyacantha chocoënsis*** Henn. sp. nov. (Plate XIX, figs. 1 and 2.)

13618, I. U. M., **Type**, male, 31 mm. 13619, I. U. M.; 5825 *a-j*,

C. M., **Paratypes**, twenty-five specimens, four males, twenty-one females, 18–35 mm. Small creek near mouth of Rio Calima, a tributary of the lower San Juan, Chocó, Colombia. Henn.

13620, I. U. M. Two males, four females, 22–37 mm. Rio Calima, small brushy creek near Boca del Guineo. Henn.

Head 3.8–4.2; depth at origin of anal, in females 4–4.2, in males 3.8; depth of caudal peduncle 6.5–7 in length without caudal and about 1.3 in head. Eye 2.5 in head; 1.5 in interorbital. Premaxillary very short, mandible longer, forming anterior border of mouth, chin steep and oblique, cleft of mouth almost vertical. Upper profile almost *horizontal*, lower gently curved.

D. 7; A. 10 (in 12 specimens); P. 12–13; V. 6; scales 28 in a lateral series, which is underlaid by a black canal; 7 in transverse series, exclusive of median dorsal series; 16–18 scales between the large occipital scale and the origin of the dorsal, predorsal region very broad and flat.

Origin of dorsal far back in both sexes, twice as distant from the anterior margin of the orbit as from the base of the caudal, or equidistant from the posterior margin of the orbit and the tip of the caudal. Origin of anal in females equidistant from base of caudal, and upper angle of gill-opening, slightly less in length than the head. In males



the origin of the anal is very slightly nearer the tip of the snout than the base of the caudal. Its length is one-third that of the entire length of the fish. Pectorals nearly equal to the head, caudal rounded or oval.

Olivaceous, margins of each scale outlined with chromatophores. Coloration more or less even throughout, except the belly, which is white or colorless. Occiput chocolate-brown; a narrow median line to dorsal, a similar line on the ventral keel of the caudal peduncle. Operculum underlaid with silvery. In specimens less than 25 mm., there are about ten, or fewer, narrow, indistinct, vertical lines of darker, distributed between the head and caudal. All mature females have a very conspicuous black area surrounding the vent. All of the fins are colorless.

Genus PRIAPICHTHYS Regan.

*Priapichthys* REGAN, Proc. Zool. Soc. London, 1913, p. 991, text-fig. 170 B.

**Type**, *Gambusia annectens* Regan.

13. *Priapichthys nigroventralis* (Eigenmann & Henn.)

*Gambusia nigroventralis* EIGENMANN & HENN, Indiana Univ. Studies, No. 16, 1912, p. 26. (Rio San Juan at Istmina.)

*Priapichthys nigroventralis* REGAN, Proc. Zool. Soc. London, 1913, p. 992.

*Gambusia caudovittata* REGAN, Ann. Mag. Nat. Hist., (8), XII, 1913, p. 471 (Rio Condoto of San Juan); Proc. Zool. Soc. London, 1913, p. 986.

4835 a, C. M., **Type**, 4835 a-e, C. M.; 12689 a-f, I. U. M., **paratypes**. Istmina. Eigenmann.

6697 a-g, C. M.; 13613 I. U. M. Fifteen, four males, eleven females, 15-25 mm. Tambo. C. E. Wilson.

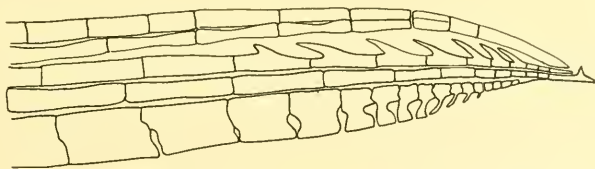


FIG. 3. *Priapichthys nigroventralis* (Eigenmann & Henn). Distal end of intromittent organ.  $\times \frac{40}{1}$ . No. 12,689, I. U. M. Istmina, Colombia.

13614, I. U. M. Four small specimens, 10-20 mm. Manigrú. Wilson.

13615, I. U. M. One male, 21 mm. Quibdo. Wilson.

6698 a-g, C. M.; 13616 I. U. M. Fifteen, seven males, eight females, 15-22 mm. Raspadura. Wilson.

6701 *a*, C. M. A single specimen. 15 mm. Rio Calima. Henn.

A brightly colored, small species, resembling *P. episcopi* (Steindachner) in the heavily pigmented anal, but having the sides of a uniform color and lacking the series of lateral spots. Basal fourth of the dorsal in the male with a heavily pigmented band, middle portion clear, outer third again pigmented. Outer portion of caudal in both sexes broadly banded with dusky.

This species occurs in the Rio Atrato and in the Rio San Juan.

#### Genus HETERANDRIA Agassiz.

*Heterandria* AGASSIZ, American Journal of Science, (2) Vol. XVI, 1853, p. 135.

In this genus the length of the male intromittent organ is about one-third of the entire length. The ventrals are minute, thoracic, and barely reach to the base of the anal.

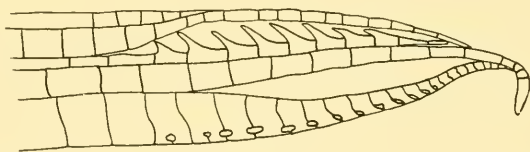


FIG. 4. *Heterandria formosa* Agassiz. Distal end of intromittent organ.  $\times \frac{40}{1}$ .  
No. 6846, I. U. M. Jacksonville, Florida.

The third or first prolonged ray of the anal of the male has the distal portion club-shaped, without serrations or hooks, the fourth ray ends in an antrorse point, the fifth ray bears dorsally a series of retrorse hooks, the sixth and seventh rays unite terminally to form the dorsal margin of the fin.

As restricted by Regan, (P. Z. S., 1913, p. 995) this genus includes the type, *H. formosa* Agassiz, ranging from the Carolinas to Florida, and *H. fasciata* (Meek) from southern Mexico. The males of the latter species have not been described.

#### 14. *Heterandria hasemani* Henn, sp. nov. (Plate XX, fig. 1.)

4663, C. M., **type**, a female, probably immature, 20 mm. 4664 *a-c*, C. M., **paratypes**, three females, 19–23 mm. Puerto Suarez, Bolivia (Paraguay Basin) May 7, 1909. Haseman.

The limited number of specimens and the lack of males, makes the generic reference doubtful. The teeth are spike-like, in several series,

and resemble those of *Heterandria formosa* Agassiz, which is the type of the genus. It is improbable that the genus *Heterandria* extends so far south, and this species may possibly be a member of *Pamphorichthys* Regan.

Head 4; depth at origin of dorsal 5.3; depth of caudal peduncle 8 in length; caudal peduncle twice in head; D. 6-7; A. 7-8; P. 9; V. 6; 27 scales in horizontal or lateral series; 7 in transverse series. The eye is rather large, 2.3 in length of head, and is equal to the interorbital width.

Body rather elongate. Origin of the dorsal about opposite to that of the anal and slightly in advance of the middle of the entire length. Fins only slightly pigmented. Pectorals reach over the middle of the ventrals, which are lanceolate, and have the middle rays longest, reaching to base of anal. Caudal rounded.

Lateral line a conspicuous black canal from the ninth scale backward. Above the lateral line the outlines of the scales are distinctly margined with dark brown chromatophores; below the lateral line these are lighter. The dark peritoneum gives a bluish appearance to the visceral cavity.

I name the species for Mr. John D. Haseman, to whose energy and zeal as a collector is to be attributed the greater portion of the collection upon which this paper is based.

Genus *NEOHETERANDRIA* Henn, gen. nov.

Intermediate between *Heterandria* and *Pseudopæcilia*.

The dentition consists of an outer series of widely spaced, long, recurved, conical teeth, with slightly expanded tips and an inner series of small, spike-like teeth in a narrow band.



FIG. 5. *Neoheterandria elegans* Henn. Distal end of intromittent organ.  $\times \frac{40}{1}$ .  
No. 5824, Carnegie Museum. Rio Truando.

Modified anal of the male, a narrow, moderately long organ with a bluntly rounded tip. First and second rays minute; third to seventh rays prolonged and modified. Third ray with a few recurved hooks

on the ventral surface near its tip. Fourth ray tapering and terminating in an abrupt downward hook. The fifth ray bears dorsally and terminally a series of four retrorse hooks and two rudiments.

15. *Neoheterandria elegans* Henn, sp. nov. (Plate XIX, figs. 4 and 5.)

5823 a, C. M., **type**, a male, 16.5 mm. **Paratypes**, 5824 a-g, C. M.

One male, 15 mm., six females, 14-16 mm.; 13612, I. U. M. Two males, 14-16 mm., six females, 14-18 mm. Rio Truando, a tributary of the Lower Atrato, in Colombia. Charles E. Wilson.

An exceedingly minute fish, greatly resembling *Heterandria formosa* in size, coloration, and general appearance. Its small size makes an accurate description difficult.

Head 4; depth at origin of anal in females 4.5, in males about 4-4.5; depth of caudal peduncle 6-7 in length to base of caudal. Eye large, about 2.3 in head and slightly less than interorbital. Snout short, 1.3 in eye. Cleft of mouth vertical, lower jaw the longer.

D. 8; A. 10; scales 28 in longitudinal series, about 8 in transverse.

Origin of dorsal over last ray of anal in females, equidistant from the base of caudal and upper angle of gill-opening. Origin of anal in females equidistant from the base of the caudal and the center of the eye. The long modified anal of the male arises at the anterior third of the total length and is about equal in length to one-third of the length of the fish. The ventrals of males are minute and thoracic and barely reach to the base of the anal.

Coloration, similar to that of *Heterandria formosa*, in having a series of from six to nine vertical bars, beginning just posterior to the visceral cavity, differing from *formosa* in having the second bar above the center of the anal in females (above the ends of the posterior anal rays in males) broadened to form a conspicuous vertically oval black spot. Dorsal and anal barred or banded with blackish.

None of the females are pregnant. They may not be mature.

#### Genus PSEUDOPÆCILIA Regan.

*Pseudopæcilia* REGAN, Proc. Zool. Soc. London, 1913, p. 995, text-fig. 170 F.

Type, *Pæcilia festæ* Boulenger.

This genus is very closely related to *Heterandria* and is in reality connected with that genus through *Neoheterandria*.

The dentition consists of an outer series of widely spaced, broadened, or expanded, incisors with recurved pointed tips, and an inner series of

much smaller spike-like teeth. In dentition, *Pseudopæcilia*, although having much heavier teeth, more closely resembles *Neoheterandria* than it does *Heterandria*.

The anal of the male is an elongate organ with a decurved tip, equalling in length about two-fifths of the length of the fish. The ventrals are minute and unmodified. The anal in males is inserted at about the second fifth of the entire length.

Another character, possibly peculiar to this genus, is the series of large pores about the margin of the pre-operculum.

#### 16. *Pseudopæcilia festæ* (Boulenger).

*Pæcilia festæ* BOULENGER, Boll. Mus. Zoöl. Torino, XIII, 1898, No. 329, p. 13, (San Vicente, near Santa Elena, Ecuador).

*Pseudopæcilia festæ* REGAN, Proc. Zoöl. Soc. London, 1913, p. 996.

No specimens of this species were secured.

#### 17. *Pseudopæcilia fria* (Eigenmann & Henn).

*Pæcilia fria* Eigenmann & Henn. Indiana Univ. Studies, No. 19, Jan. 16, 1914, p. 13 (Vinces, Ecuador).

This species may be identical with the preceding, but seems to differ in the number of scales. It has scales 3-29 or 30-4 (to ventrals). *P. festæ* is said to have 33-35 scales in a longitudinal series and 12-13 in a transverse series.

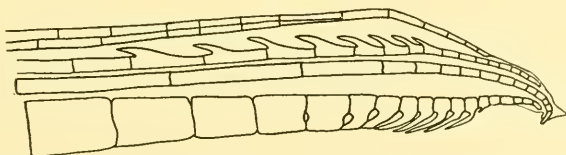


FIG. 6. *Pseudopæcilia fria* (Eigenmann & Henn). Distal end of intramittent organ.  $\times \frac{40}{1}$ . No. 13,107, I. U. M. Vincennes, Ecuador.

The anal fins show slight differences which may be specific. Regan's figure of the anal of the male of *P. festæ* shows nine or more hooks on the third prolonged ray. In all of six examples of *P. fria* examined for this character, the number of these spines is eight.

#### Genus POECILIOPSIS Regan.

*Pæciliopsis* REGAN, Proc. Zoöl. Soc. London, 1913, p. 996, text fig. 170 D.

Type, *Pæcilia presidionis* Jordan and Culver.

18. *Pæciliopsis amates* (Miller).

*Pæcilia amates* MILLER, Bull. Am. Mus. Nat. Hist., XXIII, 1907, p. 108, fig. 1 (Los Amates, Guatemala).

This is a valid species of the genus *Pæciliopsis* as shown by the structure of the anal fin of the male. (Cf. Fig. 7.) *Pæciliopsis pittieri* (Meek); Field Mus. Pubs. Zoöl., X, 1912, p. 71, from La Junta, Costa

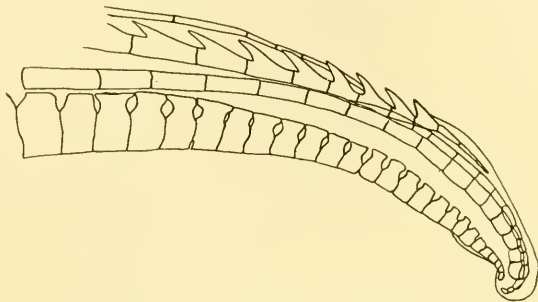


FIG. 7. *Pæciliopsis amates* (Miller). Distal end of intramittent organ.  $\times \frac{40}{1}$ , No. 11,375, I. U. M. Los Amates, Guatemala.

Rica, may be identical with this species. These two and the following species are the only members of the genus with distinct cross-bars or color-bands, which in most cases are confined to the male.

19. *Pæciliopsis colombiana* (Eigenmann & Henn.).

*Heterandria colombianus* EIGENMANN & HENN, Indiana Univ. Studies, No. 16; 1912, p. 27 (Rio Dagua, Colombia); REGAN, Proc. Zoöl. Soc. London, 1913, p. 996.

This well-marked species is different in coloration from the other members of the genus. The distinct chocolate streaks extend the full height of the fish, are widely spaced, and are equally distinct in both sexes.

## Genus PHALLOPTYCHUS Eigenmann.

*Phalloptychus* EIGENMANN, Proc. U. S. Nat. Mus., XXXII, 1907, p. 430, fig. 6. REGAN, Proc. Zoöl. Soc. London, 1913, p. 999.

Type by original designation *Girardinus januaris* Hensel.

The dentition consists of an outer series of compressed, slightly recurved, spoon-oar-shaped teeth, with a broad band of minute, club-shaped teeth immediately behind them.

Anal of the male, when folded, *i. e.*, in the normal state, a long, needle-



like intromittent organ, contained 2.2 to 2.3 in the entire length. It is inserted forward of the anterior third of the entire length. Ventrals anterior to the origin of the anal, minute; rays not modified. Male elongate, greatest depth about 5 in length to base of caudal. Eigenmann, *loc. cit.*, p. 430, fig. 6, gives excellent figures of the male anal fins.

First and second anal rays of the male, minute; third, fourth, and fifth greatly prolonged. In the normal folded position, these lie closely apposed, forming a simple needle-shaped organ. Distal part of third ray club-shaped, near the tip free from the fourth, which tapers evenly and bears dorsally a series of strong, retrorse hooks. These lie downward or enclose the folded organ. Fifth ray heavy and tubular, closely joined to the fourth. Other rays much shorter. *Cnesterodon* differs from this genus in the presence of a long terminal hook.

KEY TO THE SPECIES OF PHALLOPTYCHUS.

a. D. 8; A. 9; V. 6; depth 4; vertical bands usually nine or fewer.

1. *eigenmanni* Henn.

aa. D. 9; A. 10; V. 5; depth 3.5, vertical bands usually more than nine.

2. *januarius* (Hensel).

20. **Phalloptychus eigenmanni** Henn, sp. nov. (Plate XX, figs. 2 and 3.) 4665 C. M., **type**, female, 29 mm. 4666, C. M., **paratypes**, two males, 20–22 mm.; eight females, 25–30 mm. Alagoinhas, Rio Catu, Bahia. March 4, 1908. Haseman.

D. 8; A. 9; P. 10; V. 6; head 4; equal to depth at origin of anal; caudal peduncle 6 in length to base of caudal and 1.5 in head. Eye 3 in head; 2 in caudal peduncle and equal to the interorbital width. Scales 27–29 in lateral series, 8 in transverse series. Snout short, 1.3 in eye; chin steep.

Distance from tip of snout to origin of dorsal, slightly less than distance from anal origin to tip of middle caudal rays. Dorsal origin over last rays of anal. Pectorals as long as the head minus the snout; ventrals just reaching the vent. Caudal elongate, rounded.

A series of from seven to nine vertical bands of color adorn the sides. The last two are often united to form a trident. Peritoneum silvery; color-bands absent over the visceral cavity.

This species differs from *P. januarius* (Hensel) in the more elongate form, smaller dorsal and anal, larger ventrals, and the fewer color-bands.

Named in honor of my respected professor, Dr. C. H. Eigenmann.

21. *Phalloptychus januarius* (Hensel).

- Girardinus januarius* HENSEL, Arch. für Naturgesch., XXXIV, 1868, p. 360; *ibid.*, XXXVI, 1870; EIGENMANN & EIGENMANN, Proc. U. S. Nat. Mus., XIV, 1891, p. 65; VON IHERING, Süßwasserf. v. Rio Grande do Sul, 1893, p. 28; STEINDACHNER, Sb. Akad. Wiss. Wien, CXVI, 1907, p. 492.
- Pæcilia januarius* EIGENMANN, Ann. N. Y. Acad. Sci., VII, 1894, p. 636.
- Glaridodon januarius* BERG, Anales Mus. Nac. Buenos Aires, V, 1897, p. 289 (in part).
- Phalloptychus januarius* EIGENMANN, Proc. U. S. Nat. Mus., XXXII, 1907, p. 431; Repts. Princeton Univ. Exp. Patagonia, III, 1910, p. 458; REGAN, Proc. Zool. Soc. London, 1913, p. 999, Pl. C., figs. 7, 8 and text fig. 171 A.
- Girardinus iheringii* BOULENGER, Ann. Mag. Nat. Hist., Oct., 1889, p. 266; EIGENMANN & EIGENMANN, Proc. U. S. Nat. Mus., XIV, 1891, p. 65.
- ? *Gambusia gracilis* PERUGIA, Ann. Mus. Civ. Stor. Nat. Genova., X, (2), 1891, p. 652.

*Range:* Santa Catharina, Rio Grande do Sul, and Uruguay.

D. 9; A. 10; P. 10; V. 5; head 3.8-4; equal to from .82-.87 of the depth at the origin of the anal; this depth 3.1-3.6 in length to base of caudal; caudal peduncle 6.4-6.7 in length and 1.5-1.7 in head. Eye 3.5 in head; 2 in caudal peduncle; equal to interorbital. Scales 29 in lateral series, 8 in transverse series.

The vertical color-bands in this species are narrower and more numerous than in the preceding. They vary in number from nine to twelve.

No specimens were secured by Mr. Haseman. This description is based upon adult females from Rio Grande do Sul, received from Dr. H. von Ihering (Ind. Univ. Mus. No. 4899).

This species has been confused by Garman<sup>5</sup> and others following him, with *Girardinus caudomaculatus* Hensel (*Phalloceros*). Garman considered the two to be identical, and, since *Girardinus januarius* Hensel stood first in pagination, *G. caudomaculatus* should have become a synonym of *G. januarius*. Garman placed *G. januarius* in his new genus *Glaridodon*, with *Girardinus uninotatus* Poey of Cuba as the type. *Glaridodon* was later shown to be pre-occupied and replaced by Garman<sup>6</sup> with *Glaridichthys*. It is quite evident from Garman's figure of a male of "*Glaridodon januarius*" (Plate VIII, fig. 15) showing the antler-like processes, that his specimens were not this species, but were *G. caudomaculatus*.

<sup>5</sup> The Cyprinodonts, Mem. Mus. Comp. Zoöl., XIX, No. 1, 1895, p. 42.

<sup>6</sup> *American Naturalist*, XXX, 1896, p. 232.

Garman was followed by Berg<sup>7</sup> in confusing the two species, in a more elaborate synonymy than had been given by Garman. Eigenmann<sup>8</sup> in 1907, maintained the separateness of the two species and created for *G. januarius*, a new genus, *Phalloptychus*, based on the long unhooked anal of the male. For *G. caudomaculatus* was created the genus *Phalloceros*, based upon the antler-like processes at the tip of the male intromittent organ.

Philippi<sup>9</sup> in an excellent résumé of the published records, again confused the two species and considered them identical. His illustrations (Tafel I, figs. 1 and 4) show that he actually had *P. caudomaculatus*, and did not have *P. januarius*. Taf. I, fig. 3 illustrates an "Unvollständig ausgebildetes Gonopodium eines subadulten Männchens von *G. januarius*, ohne Klammerapparat (*Phalloptychus*-stadium)." This type of anal without hooks is found in developing males of most viviparous genera, and does not represent the type of structure on which *Phalloptychus* is based.

#### Genus PHALLOCEROS Eigenmann.

*Phalloceros* EIGENMANN, Proc. U. S. Nat. Mus., XXXII, 1907, p. 431, fig. 7; REGAN, Proc. Zool. Soc. London, 1913, p. 999.

Type by original designation *Girardinus caudomaculatus* Hensel.

There is an outer series of compressed, oar-shaped teeth, which on each ramus flare outward toward the angle of the mouth. Their margins toward the tips are in contact and only the tips protrude from the jaw. Behind these, lies an inner series of very small, conical teeth.

The anal fin of the male is modified into a long, intromittent organ, its origin slightly forward of the anterior third of the total length. Its length is contained 3.3 times in the length of the fish. Ventrals short, hardly reaching the anal, their origin directly below that of the pectoral. Caudal rounded.

First and second anal rays in the male minute; third, fourth, and fifth anal rays united and greatly prolonged; other rays much shorter. The tip of the fin bends gracefully downward; the fourth ray ends in an obtuse point, bent downward at right angles to the rest of the fin.

<sup>7</sup> *Anales del Mus. Nac. de Buenos Aires*, V, 1897, p. 289.

<sup>8</sup> *Proc. U. S. Nat. Mus.*, XXXII, 1907, p. 425.

<sup>9</sup> "Fortpflanzungsgeschichte der viviparen Teleostier *Glaridichthys januarius* und *G. decem-maculatus* in ihrem Einfluss auf Lebensweise," etc., *Zoologische Jahrbücher*, XXVII, 1908, pp. 4 et seq.

The fourth ray bears dorsally a series of recurved hooks, which are protected by the fifth. At the tip, the organ bears on the under side two antler-like processes. These bear a prong near their tips.

*Girardinus* and *Glaridichthys* of Cuba differ from each other by the presence in the latter of an inner series of teeth. *Phalloceros* differs from *Glaridichthys* by the lack of retrorse hooks on the posterior margin of the anal and the presence of the terminal antler-like processes. Reference should be made to the excellent figure of the generic characters, given by Eigenmann, *loc. cit.*, p. 431, fig. 7. The genus up to date has remained monotypic.

22. *Phalloceros caudomaculatus* (Hensel). (Plate XVIII, fig. 2.)

*Girardinus caudimaculatus* HENSEL, Arch. für Naturgesch., XXXIV, 1868, p. 362; *ibid.*, XXXVI, 1870; VON IHERING, Zeitsch. f. wiss. Zoöl., XXXVIII, 1883, p. 468, pl. 26; EIGENMANN & EIGENMANN, Proc. U. S. Nat. Mus., XIV, 1891, p. 65; VON IHERING, Süßwasserf. v. Rio Grande do Sul, 1893, p. 28; COPE, Proc. Amer. Phil. Soc., XXXIII, 1894, p. 102.

*Pæcilia caudomaculatus* EIGENMANN, Ann. N. Y. Acad. Sci., VII, 1894, p. 636.

*Girardinus caudomaculatus* EIGENMANN & NORRIS, Revista Mus. Paulista, IV, 1900, p. 361; EIGENMANN, Ann. Carnegie Mus., IV, 1907, p. 143.

*Phalloceros caudomaculatus* EIGENMANN, Proc. U. S. Nat. Mus., XXXII, 1907, p. 431; Repts. Princeton Univ. Exp. Patagonia, III, 1910, p. 458; REGAN.

Proc. Zoöl. Soc. London, pt. IV, 1913, p. 999, Pl. C., figs. 5, 6, and text-fig. 172 C.

*Glaridodon januarius* GARMAN, Mem. Mus. Comp. Zoöl., XIX, (1), 1895, p. 42, pl. VIII, fig. 15; BERG, Anales Mus. Nac. Buenos Aires, V, 1897, p. 289.

? *Girardinus januarius* RIBEIRO, Arch. Mus. Nac. Rio de Janeiro, XIII, 1906, p. 16. *Glaridichthys januarius* PHILIPPI, Zoöl. Jahrb., XXVII, 1908, p. 4.

The following specimens were all collected by Mr. J. D. Haseman. 4671, C. M. Seven, two males, four females, one young, 21 to 35 mm.

From Entre Rios, Rio Parahyba.

4672, C. M. One female, 25 mm. Munez Freire, Rio Itapemerim.

4673, C. M. Six, two males, three females, one young, 16-28 mm.

Barra da Pirahy, Rio Parahyba.

4674 C. M., six, two males, two females, two young. 14-32 mm.

Santa Rita de Jacutinga, Rio Preto into Parahyba.

4675 C. M., seventy-nine, seventeen males, sixty-two females. 15-41 mm. Jacarehy, Rio Parahyba, São Paulo.

4676 C. M., thirty-one, four males, twenty-seven females. 20-41 mm. Mogy das Cruzes, Rio Tieté, into Paraná.

4677 C. M., eight, two males, five females, one young. 16-30 mm. Jundiah, São Paulo.

- 4678 C. M., twenty-three, six males, fourteen females, three young. 19-56 mm. Raiz da Serra, Rio Mogy into Santos Bay.
- 4679 C. M., seven, five males, two young. 20-40 mm. Alto da Serra, Rio Tieté, into Paraná.
- 4680 C. M., four, one male, two females, one young. 9-48 mm. Cubatão, Rio Cubatão.
- 4681 C. M., twenty-one, three males, eighteen females. 22-35 mm. Mogy Guassu, Rio Mogy Guassu into Rio Grande, into Paraná.
- 4682 C. M., thirteen, three males, ten females, 21-45 mm. Salto de Avanhandava, Rio Tieté.
- 4683 C. M., five, all females; 19-37 mm. Bauru, Rio Tieté.
- 4684 C. M., fifteen, five males, eight females, two young. 18-40 mm. Iguapé, Rio Ribeira da Iguapé.
- 4685 C. M., fifteen, eleven females, four young. 8-43 mm. Morretes on Marumby into Rio Nhundiaquara.
- 4686 C. M., seventeen, one male, thirteen females, three young. 18-38 mm. Porto Alegre, Rio Grande do Sul.
- 4687 C. M., four females. 20-35 mm. Cachoeira, Rio Jacuhy, Rio Grande do Sul.
- 4688 C. M., nineteen, seven males, ten females, two young. 16-38 mm. Sapucay, Paraguay.
- 4689 C. M., three females. 17-28 mm. Villa Hays, Rio Confusso, into Rio Paraguay.

*Range:* Rio de Janeiro to Uruguay and Paraguay.

Head 4.1-4.2; depth at origin of anal, in females 4.2-4.5, in males 4; depth of caudal peduncle, 7.2-8.5 in length to base of caudal, 1.7-2 in head; D. 8; A. 10; P. 10; V. 5; 29-30 scales in lateral series; 8 in transverse series. Eye equal to interorbital; 2.8 in head.

Origin of the dorsal about midway in the total length, slightly posterior or opposite to anal origin. Pectorals large, extending over ventrals; caudal rounded.

General color in spirits olivaceous, scales margined with darker. Fins usually immaculate, sometimes spotted or tipped with chromatophores. The most conspicuous marking is a vertical spot of black, slightly posterior to the dorsal, on the seventeenth or eighteenth scale posterior to the pectoral origin; the twelfth or thirteenth scale forward from the caudal, the fourth scale obliquely from the dorsal. The darkened area usually extends under adjoining scales, forming a spot about half the diameter of the eye. In young specimens, a

series of very faint, narrow, vertical bars appears on the sides, in one of which the spot appears.

Some variations from this general type of coloration occur. In the series of seven specimens from Entre Rios, the caudal spot is entirely lacking, faintly vermiculated bars taking its place. The same condition prevails in a number of specimens from Raiz da Serra.

In a series of twenty-one specimens from Mogy Guassu, this variation is considerable. These specimens have a series of oblong spots extending along the sides, varying in number from seven to the usual single spot. This latter spot always appears in the proper place. Hardly two individuals are alike.

In the two hundred and sixty-two mature specimens in these collections, there are fifty-five males and two hundred and seven females. The sex ratio of this species, as here represented is thus 1 : 3.76. The largest specimen, a pregnant female from Raiz da Serra, is 55 mm. in total length. This specimen was opened and found to contain thirty-nine well-developed embryos. The alimentary tract was about three times as long as the entire fish and was filled with mud.

On account of the confusion of this species with *Phalloptychus januarius*, I have given the complete synonymy of the two species. When males are present, there should be no confusion, since the structure of the anal fins is entirely different.

### **Phallotorynus**<sup>10</sup> Henn, gen. nov.

Allied to *Phalloceros*. Distinguished at once from all described genera of the *Pæciliidæ* by the peculiar terminal organ of the anal fin of the male, which resembles a garden trowel or scoop. Anal in

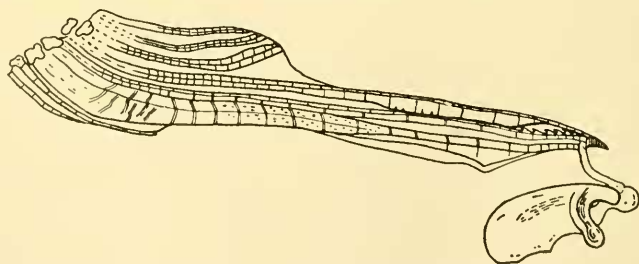


FIG. 8. *Phallotorynus fasciolatus* Henn. Side view of anal fin of male.  $\times 9.5$ . No. 3753a, Carnegie Museum. Jacarehy, São Paulo, Brazil.

<sup>10</sup>  $\phi\alpha\lambda\lambda\acute{o}s$ , intromittent organ;  $\tau\omicron\rho\acute{o}\nu\eta$ , trowel.



the male inserted at about the proximal third of the entire length; ventrals thoracic, minute, not modified. First and second anal rays of the male minute; third, fourth, fifth, and sixth, much prolonged. The third ray forms an obtuse angle near its tip, where it is produced dorsally, joining the tip of the fourth to form the pedicle of the terminal process. The fifth ray is longest, terminating in a point; posteriorly there is a series of about six retrorse hooks upon its dorsal ridge. Sixth ray compressed posteriorly, bending ventrally to join the fifth. Seventh, eighth, and ninth rays normal, successively shorter. The terminal organ has the form of a scoop and there is a compressed horn or extension on each side. This is poised at right



FIG. 9. *Phallotorynus fasciolatus* Henn. Inferior view of premaxillaries with teeth. One tooth probably missing from left ramus.  $\times 26$ . No. 3754, Carnegie Museum.

angles to the pedicle. There is a single series of teeth, shaped like spoon-oars, in each jaw. The tips of the teeth are slightly expanded and bent backward. The intestine is about twice the length of the entire fish.

This remarkable little fish has attained a high degree of complexity in the apparatus for the transfer of spermatozoa to the female. The sperm-duct, as in related genera, opens backward at the very base of the anal. The sexual products probably appear in the form of the sperm-aggregations, the occurrence of which in *Phalloceros caudomaculatus* has already been mentioned. The hinder portion of the anal fin seems to be somewhat flexible and may fold over the inflexible prolonged rays, to form a groove or trough which would have the open side along the ventral edge. The close apposition of the two edges of the fin would form a channel for the conduction of the sexual products. The ventral fins are too small to be of service, but the pectoral fins, although small, by being placed over the mouth of the sperm duct, may cause the entrance of the sexual products into this

groove. The scoop or terminal process of the anal fin, if movement of the handle or pedicle is possible, could be raised to receive the spermatozoa as they issue from the end of the trough. By the usual movements during copulation they could then be placed on the genital papilla of the female. Since the living fish has not been observed, these remarks are naturally conjectural.

Views of the terminal process of the intromittent organ from both above and below are shown in Figs. 10 and 11. It was suggested that

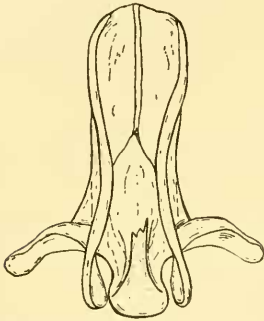


FIG. 10.

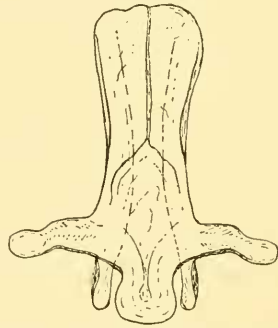


FIG. 11.

FIG. 10. *Phallotorynus fasciolatus* Henn. View from above of terminal portion of anal, detached from the pedicle.  $\times 18$ . No. 3753a, Carnegie Museum. Jacarehy, São Paulo, Brazil.

FIG. 11. View from below of same object shown in Fig. 10.  $\times 18$ .

this might be an elaborate device for enclosing the spermatozoa, somewhat analogous to the egg case of the skate. Accordingly one of them was decalcified, imbedded, and cut into very thin sections and stained with iron-alum hæmatoxylin. This procedure showed conclusively that the terminal process is not a sperm case, but is an



FIG. 12.



FIG. 13.

FIG. 12. *Phallotorynus fasciolatus* Henn. Section through center of terminal portion of anal.  $\times 30$ .

FIG. 13. *Do.* Section through posterior portion of terminal part or scoop of the anal.  $\times 30$ .

actual part of the fin. If used, as suggested above, for the transference of spermatozoa, it was empty at the time of capture. Sections near the center and through the posterior portion respectively, are shown in figures 12 and 13. Other than in the character of the anal fin, or intromittent organ, this fish does not greatly differ from a number of related species.

23. *Phallotorynus fasciolatus* Henn, sp. nov. (Plate XXI, figs. 1 and 2.)

3752, C. M., **type**, male, 20 mm.; 3753 *a-b*, C. M., **paratypes**, two males, 19.5–22 mm., eight females, 20.5–28.5 mm. One mile north of Jacarehy, São Paulo, Brazil, from the basin of the Rio Parahyba, July 14, 1908. Haseman.

Head 4.4–4.6; depth at origin of anal 4–4.5; depth of caudal peduncle 5.5–6; D. 8; A. 11 (male 9); P. 10; scales 28–30 + 1 from upper angle of gill-opening to caudal; fourteen scales between large occipital scale and origin of the dorsal; nine scales in a transverse series. Eye 1.5 in the interorbital width, 2.5 in the head; interorbital 1.6 in the head. Snout and head broad, depressed; profile slightly arched; mouth vertical, premaxillaries protractile. Second dorsal ray in the female nearly over the last ray of the anal. Origin of the dorsal slightly in advance of the middle of the total length. The anal of the male, exclusive of the clasper, equals about one-fourth of the total length. Pectorals large, reaching to above middle of ventrals; the latter minute, barely reaching the vent. Caudal rounded, hyaline. Viviparous. A female which was examined contained nine large yolk-laden ova. Intestine about twice the total length; fins are usually without pigment; the dorsal and anal fins of a few specimens are pigmented. Sides with six or seven narrow, vertical bands, or streaks of dark brownish pigment.

Genus *CNESTERODON* Garman.

*Cnesterodon* GARMAN, Mem. Mus. Comp. Zoöl., XIX, (1), 1895, p. 43; REGAN, Proc. Zoöl. Soc. London, pt. IV, 1913, p. 1000.

*Gulapinnus* LANGER, Morph. Jahrb., XLVII, 1913, p. 207.

Type of genus, by original designation *Pæcilia decem-maculatus* Jenyns.

The dentition consists of an outer series of compressed, slightly recurved, spatulate incisors, with a single series of small conical teeth just behind them.

Anal of the male a long intromittent organ, inserted below the pectorals. Its length is about 1.7 that of the head. First and second anal rays minute; third, fourth, fifth, and sixth, prolonged. Fourth ray terminating in a point, immediately ventral to this, a *single* long sickle, or hook. Fifth ray bearing near its upturned tip a series of retrorse hooks. Sixth ray bending ventrally; near its tip a sharp recurved spine. Other rays successively shorter.

Garman based this genus on immature males, the anals of which were plain sword-like organs without hooks. A good figure of the male anal of *Cnesterodon* is given by Philippi, *Zoöl. Jahrb.*, XVII, 1908, p. 19, fig. B.

*Phalloceros* differs from this genus by the possession of two much smaller hooks or antler-like processes.

#### 24. *Cnesterodon decem-maculatus* (Jenyns).

*Pæcilia decem-maculatus* JENYNS, Beagle Zoöl., Fishes, 1842, p. 115 (Maldonado).  
*Girardinus decem-maculatus* BOULENGER, Boll. Mus. Torino., X, No. 196, 1895, p. 3 (Buenos Aires); LAHILLE, Revista Mus. de la Plata, VI, 1895, p. 275 (La Plata);  
 BOULENGER, Boll. Mus. Torino, XII, No. 279, 1897, p. 4 (Caiza, Bolivian Chaco.)  
*Cnesterodon decem-maculatus* GARMAN, Mem. Mus. Comp. Zoöl., XIX, (1), 1895, p. 44, pl. V, fig. 13, teeth; pl. VIII, fig. 16, male (Uruguay River, Maldonado);  
 BERG, Ann. Mus. Nac. Buenos Aires, V, 1897, p. 290 (Argentina, Uruguay, Brazil); EVERMANN & KENDALL, Proc. U. S. Nat. Mus., XXXI, 1906, p. 90 (Argentina); EIGENMANN, Proc. U. S. Nat. Mus., XXXII, 1907, p. 431 (Rio Grande do Sul); EIGENMANN, Repts. Princeton Univ. Exp. Patagonia, III, 1910, p. 458; REGAN, Proc. Zoöl. Soc. London, 1913, p. 1000, fig. 172 B.  
*Glavidichthys decem-maculatus* PHILIPPI, Zoöl. Jahrb., XVII, 1908, pp. 10 *et seq.*  
*Cnesterodon carnegiei* HASEMAN, Ann. Carnegie Mus., VII, 1911, p. 385, pl. LXXXIII (Serrinha Paraná, Rio Iguassú).

4661, C. M. Three; two males, one female. 18-22 mm. Cacequy, Rio Ibicuhy, Rio Grande do Sul.

4662, C. M. Two; male and female. 19-20 mm. Monté, Argentina.

The following description is based upon paratypes of *Cnesterodon carnegiei* Haseman, which seems to be identical with *C. decem-maculatus*.

Head 4.2-4.8; equal to depth at origin of dorsal; depth of caudal peduncle 7.5-8.6 in length; caudal peduncle about 1.5 in head. Snout short and blunt; mouth oblique; snout 1.2 in eye. Eye medium; 3-3.5 in head.

A male has the head 5; depth at origin of dorsal 5; caudal peduncle 7.1 in length and 1.4 in head.

D. 8-9; A. 9-10; P. 10; V. 4-5; scales 28-31 in lateral line series; 8-9 in transverse series.

Broadly depressed anteriorly, compressed posteriorly. Profile slightly arched. Distance from tip of snout to origin of dorsal in females about equal to the distance from last ray of anal to tip of caudal. Origin of dorsal slightly posterior to vertical from the origin of the anal. Ventrals small, barely reaching the vent, caudal rounded.

A series of oblong vertical spots or bars on the sides of the fish. These vary in number from six to twelve, their number is usually about nine. Males have a prominent V-shaped mark immediately ventral to the dorsal, which is produced into a line of pigment on the keel of the caudal peduncle.

#### Genus PÆCILIA Schneider.

*Pæcilia* BLOCH, Syst. Ichth.; 1801, p. 451; GARMAN, Mem. Mus. Comp. Zool., Vol. XIX, 1895, p. 52; REGAN, Proc. Zool. Soc. London, 1913, p. 1005.

Type, *Pæcilia vivipara* Bloch and Schneider.

As now restricted by Regan, this genus comprises a few species limited to the northeastern portion of South America.

The anal fin of the male is shorter than the head and very similar in structure to that of *Lebistes* and *Mollienisia*, from both of which it differs in the absence of the modified terminal segment of the third prolonged ray.

Photographs of all of the species, except *P. branneri*, which has never been figured, are given by Eigenmann in Memoirs Carnegie Museum, Vol. V, pl. LXIV-LXVI.

#### 25. *Pæcilia vivipara* Bloch & Schneider.

*Pæcilia vivipara* BLOCH & SCHNEIDER, Syst., Ichth., 1801, p. 452, pl. 86, fig. 2; GARMAN, Mem. Mus. Comp. Zool., XIX, (1), 1895, p. 53; EIGENMANN, Repts. Princeton Univ. Exp. Patagonia, III, 1910, p. 460; EIGENMANN, Mem. Carnegie Museum, V, 1912, p. 456, pl. LXIV, fig. 3, male, fig. 4, female (Georgetown, Brit. Guiana); REGAN, Proc. Zool. Soc. London, 1913, p. 1005, fig. 173 C.

? *Pæcilia amazonica* Garman, Mem. Mus. Comp. Zool., XIX, (1), 1895, p. 64, pl. IV, fig. 9, teeth (Santa Cruz, Para).

The following specimens were all collected by Haseman.

4646, C. M., seventeen, three males, twelve females, two young. 13-48 mm. Alagoinhas, Rio Catu, Bahia.

4647, C. M., eleven, 9-18 mm. Maceio, Rio San Francisco.

4648, C. M., fifteen, two males, eight females, five young. 14-37 mm. Penedo, Alegoas, Brazil.

4649, C. M., ten, 15-41 mm. Barra de Penedo, Rio San Francisco.

- 4650, C. M., twenty-eight, three males, twenty-four females, one young.  
17-70 mm. Cachoeira, Rio Paraguassú.
- 4651, C. M., five, one male, three females, one young. 11-42 mm.  
Campos, Rio Parahyba.
- 4652, C. M., forty-eight, three males, forty-five females. 25-51 mm.  
Munez Freire, Rio Itapemerin.
- 4653, C. M., five, one male, four females. 29-43 mm. São João da  
Barra, Parahyba.
- 4654, C. M., eleven. 10-21 mm. Alto da Serra, São Paulo.
- 4655, C. M., two. 46-61 mm. Iguapé, Rio Ribeira da Iguapé.  
From R. Krone.
- 4656, C. M., twelve, three males, nine females. 38-50 mm. Iguapé.  
Rio Ribeira da Iguapé.
- 4657, C. M., three. 12-24 mm. Bom Jesus dos Meiras, Rio San  
Francisco.
- 4658, C. M., one. 30 mm. Raiz da Serra, São Paulo.

Some variation occurs in different localities, particularly in the number of dorsal and anal fin-rays. Specimens from localities in the southern part of its range show the shortened dorsal said by Garman to be characteristic of *P. amazonica*. However, such complete gradation exists in a single locality, that separation into two species is not possible. *P. amazonica*, said by Garman to be closely related to *P. vivipara*, is probably synonymous with it. I have not been able to examine typical specimens.

## 26. *Pæcilia paræ* Eigenmann.

*Pæcilia vivipara paræ* EIGENMANN, Ann. N. Y. Acad. Sci., Vol. VII, 1894, p. 629 (Pará).

*Pæcilia paræ* REGAN, Proc. Zool. Soc. London, 1913, p. 1006, text-fig. 173b (anal).

*Acanthophaclus bifurcus* EIGENMANN, Mem. Carnegie Mus., Vol. V, 1912, p. 459, pl. LXV, figs. 4, 5, and 6.

I am not positive that *P. bifurcus* is a synonym of *P. paræ*, although it is quite certain that *bifurcus* is a *Pæcilia*. Typical specimens of *P. paræ* are too much shrunken to permit a final decision.

## 27. *Pæcilia melanzona* (Eigenmann).

*Acanthophaclus melanzonus* EIGENMANN, Ann. Carnegie Mus., Vol. VI, 1909, p. 51; Mem. Carnegie Mus., Vol. V, 1912, p. 457, pl. LXIV, fig. 5.

1086, C. M. Type, male, 27 mm. Georgetown, British Guiana.



Eigenmann based this species on a male, as the type, with which were associated seven females, which seem to belong to a distinct species, subsequently described by Regan as *P. picta*. The apparent

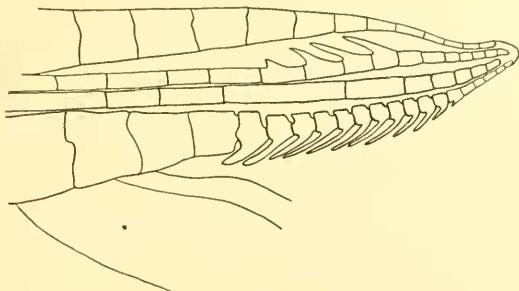


FIG. 14. *Pæcilia melanazona* (Eigenmann). Distal end of anal of male.  $\times \frac{40}{1}$ .  
No. 1,086, Carnegie Museum. Georgetown, Brit. Guiana.

differences between the single male and the females were supposed to be those of sexual dimorphism. Regan's material contained males agreeing in coloration with these females, to which they unquestionably belong, showing their specific distinctness from *P. melanazona*. Regan's supposition that the type of *A. melanazonus* is a male of *Lebistes reticulatus* is erroneous, as will be seen by reference to the accompanying figure of the anal fin, which is that of a *Pæcilia*.

The type, which is unique, has a broad lateral band of clear white or silvery, bordered by narrow lines of chocolate. Females of this species are unknown.

## 28. *Pæcilia picta* Regan.

*Acanthophaeus melanzonus* EIGENMANN (*in part*, females), Ann. Carnegie Museum, Vol. VI, 1909, p. 51; Mem. Carnegie Museum, Vol. V, 1912, p. 457, pl. LXIV, fig. 6.

*Pæcilia picta* REGAN, Proc. Zool. Soc. London, 1913, p. 1007, pl. C, fig. 1, 2, and text-fig. 173 A (Demerara).

As stated in the remarks under *Pæcilia melanazona*, that species was a composite based upon a male (type) and several females supposed to belong to it, but shown by males in Regan's material to be distinct and described by him as the present species. Both are distinct and valid species of the genus *Pæcilia*. Males and females of this species are more or less similar in coloration.

29. *Pœcilia branneri* Eigenmann.

*Pœcilia branneri* EIGENMANN, Ann. N. Y. Acad. Sci., VII, 1894, p. 629. (Santarem, Pará); EIGENMANN, Repts. Princeton Univ. Exp. Patagonia, III, 1910, p. 460; REGAN, Proc. Zoöl. Soc. London, 1913, p. 1007.

*Pœcilia heteristia* REGAN, Ann. Mag. Nat. Hist., (8) Vol. III, 1909, p. 235 (Para); EIGENMANN, Repts. Princeton Univ. Exp. Patagonia, III, 1910, p. 460.

No specimens were secured by Haseman.

I have examined the typical specimens; one male, 22 mm., five females, 16–25 mm., Nos. 5082 and 5084, I. U. M. Four of the females are in a very poor state of preservation.

This species differs from *Lebistes reticulatus* Peters, with which it was considered identical by Garman (The Cyprinodonts, p. 62) in the male anal structure, fin formulæ, and coloration.

*P. branneri* has D. 7; A. 8; V. 6; P. 13.

*L. reticulatus* has D. 6–7; A. 10; V. 6; P. 12.

In *P. branneri* both sexes have a single vertical oblong spot at the base of the caudal; in *L. reticulatus* only the males possess spots, these number two or three, vary in location, and are usually circular.

In the single male of *P. branneri*, the last two rays of the dorsal are greatly prolonged and extend over the middle of the caudal. In males of *L. reticulatus*, the dorsal is normal.

Head 3.8; equal to depth at origin of dorsal; caudal peduncle 5.4 in length. Eye about 3 in head.

Dorsal origin posterior to that of anal, about in the middle of total length. Ventrals lanceolate (in females), reaching almost to origin of anal. Caudal rounded.

## Genus LEBISTES Filippi.

*Lebistes* FILIPPI, Arch. Zoöl. Anat. Fisiol., Vol. I, 1861, p. 69.

*Acanthophaelus* EIGENMANN, Proc. U. S. Nat. Mus., Vol. XXXII, 1907, p. 426, fig. 1.

30. *Lebistes reticulatus* (Peters).

*Pœcilia reticulata* PETERS, Monatsb. Akad. Berlin, 1859, p. 412; Garman, Mem. Mus. Comp. Zoöl., Vol. XIX, 1895, p. 62.

*Lebistes reticulatus* REGAN, Proc. Zoöl. Soc. London, 1913, p. 1008.

Through the kindness of the late Dr. S. E. Meek, of the Field Museum of Natural History of Chicago, I have been enabled to examine the specimens recorded by him as *Girardinus vandepolli* (Van Lidth de Jeude) from Curaçao, an island of the Dutch West Indies (Pubs. Field Col. Mus., 1909, Zoöl. Series, Vol. VII, No. 7, p. 209).

These agree in all respects with typical specimens of *Lebistes reticulatus* from Barbadoes.

### Genus MOLLIENISIA Le Sueur.

*Mollienisia* LE SUEUR, Journ. Acad. Nat. Sc. Phila. II, 1821, p. 3; REGAN, Proc. Zool. Soc. London, 1913, p. 1010.

This genus is very closely related to *Pæcilia*, from which it differs in having an obtuse downward point at the end of the first prolonged ray of the anal and another segment, directed dorsally, as in *Lebistes* at the tip of the fourth prolonged ray. The chief difference between *Pæcilia* and *Mollienisia* is the longer dorsal in the latter. *Pæcilia*, *Mollienisia*, and *Lebistes* might be considered members of the single comprehensive genus, *Pæcilia*.

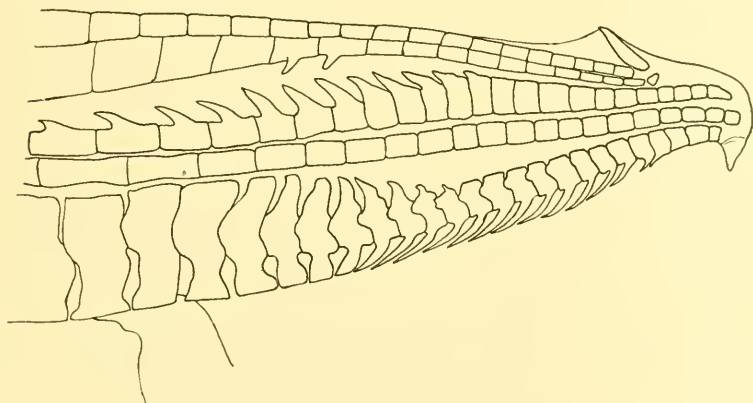


FIG. 15. *Mollienisia latipinna* Le Sueur. Distal end of anal of male.  $\times \frac{40}{1}$ .  
No. 9201, I. U. M. Baldwin Lodge, Mississippi.

The anal of the male is shorter than the head and slightly more than one-fifth of the total length. The ventrals are set close to the anal; the second ray, or the ray next the outer one, is prolonged into a club-shaped filament, which is almost as long as the anal and extends to or beyond the middle of that organ. The ventral part of the tip of the fin has a prepuce or dermal hood as in *Pæcilia* and *Lebistes*.

Type of the genus *M. latipinna* Le Sueur.

31. *Mollienisia sphenops* (Cuvier and Valenciennes).

*Pæcilia sphenops* CUV. & VAL., Hist. Nat. Poiss., XVIII, 1846, p. 130, pl. 526.  
*Mollienisia sphenops* REGAN, Proc. Zool. Soc. London, 1913, p. 1013, text-fig. 173F.  
 6699 *a-c*, C. M.; 13617, I. U. M., six. 47-57 mm. Brackish water  
 at Cartagena, Colombia. C. H. Eigenmann.

In addition to these examples, the University of Michigan possesses a few specimens from fresh waters at Santa Marta and the Rio Manzanares near Santa Marta and Mamatoco, in the Santa Marta Mountains of Colombia.

32. *Mollienisia caucana* (Steindachner).

*Girardinus caucanus* STEINDACHNER, Denkschr. K. K. Akad. Wiss. Wien. XLII, 1880, p. 87, pl. VI, figs. 4, 5 (Caceres, Colombia); STEINDACHNER, *ibid.*, LXXII, 1902, p. 146 (Baranquilla).

5826 *a*, C. M. A single female 34 mm., Cienaga at Calamar, Colombia. Eigenmann.

A male, 22 mm., from Fundación is in the collection of the University of Michigan. The tip of the anal fin of this specimen is shown in Fig. 16.

D. 7-8; A. 9; P. 10; V. 6; l. l. .26-27. •

This species is very closely related to *M. sphenops* and seems to differ chiefly in coloration. It has the basal half of the dorsal broadly banded with intense black, thence a clear portion, which is again

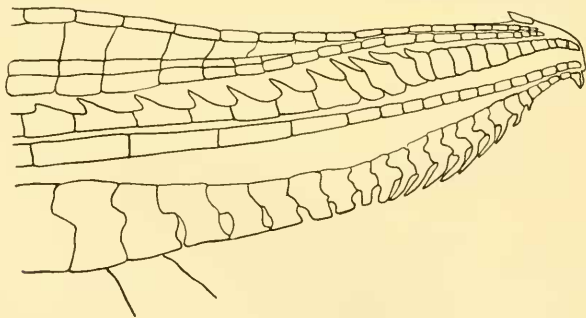


FIG. 16. *Mollienisia caucana* (Steindachner). Distal end of anal of male.  $\times \frac{40}{1}$ .  
 Fundación, Colombia.

margined with black. The base of the last rays of the anal in the female is also covered by a black spot. There are faint indications of a number of transverse lines on the sides.

The structure of the anal of the male seems also to differ in the lesser number of segments with ventral hooks in the first prolonged ray and in the absence of spinous or dorsal processes on these segments. The first and second prolonged rays are more clearly separated in *M. caucana*. These specific differences in anal structure exist between specimens of the same size.

Genus LIMIA Poey.

*Limia*, POEY, Memorias Cuba, Vol. I, 1855, p. 383; REGAN, Proc. Zool. Soc. London, 1913, p. 1014.

Type, *Limia cubensis* Poey = *Pæcilia vittata* Guichenot.

This genus, while closely related to *Pæcilia*, *Mollienisia*, and *Lebistes*, is distinguished from these genera by the absence of forward-projecting spines on the ventral portion of the segments in the first prolonged ray of the anal. This ray is club-shaped and without

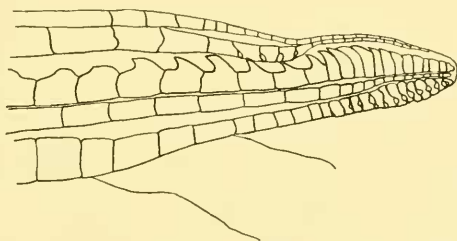


FIG. 17. *Limia hollandi* Henn. Distal end of anal of male.  $\times \frac{40}{1}$ .  
No. 4640, Carnegie Museum. Boqueirão, Brazil.

serrations. The third prolonged ray bears the usual dorsal serrations. In most of the species, but not in the present, there is an antrorse spine on the ventral surface near the extremity of the first prolonged ray.

The anal of the male is shorter than the head; the ventrals are equal to the head in length and are lancolate in shape. A dermal hood or prepuce occurs near the extremity of the fin.

This genus includes eight species, seven of which are from Cuba, Haiti, and Jamaica, and one from the mainland at La Guayra, Venezuela. The present new species is from the basin of the Rio San Francisco and neighboring streams of Brazil.



33. *Limia hollandi* Henn, sp. nov. (Plate XIX, fig. 3.)

4643, C. M., **type**, female, 34 mm.; 4643 b-d, C. M., **paratypes**, three females, 13-34 mm. From Penedo, Rio San Francisco. Haseman.

Other specimens collected by Haseman are:

4635, C. M., seven females, 26-29 mm. Lagoa, Barreiras, Rio San Francisco.

4636, C. M., five females, 15-32 mm. Baixa Grande, Rio Paqui.

4637, C. M., one female, 21 mm. Joazeiro, Rio San Francisco.

4638, C. M., two females, 27-28 mm. Cachoeira de Pirapora, Rio San Francisco.

4639, C. M., eleven, three males, eight females, 19-24 mm. Lagoa de Porto, Rio San Francisco.

4640, C. M., twelve, two males, eight females, two young. 16-26 mm. Boqueirão, Rio Grande, Rio San Francisco.

4641, C. M., twelve females, 18-27 mm. Santa Rita de Rio Preto.

4642, C. M., five females, 18-33 mm. Rio Itapicurú near Timbo, Bahia.

4644, C. M., one female, 28 mm. Alto da Serra, São Paulo.

4645, C. M., three females, 41-43 mm. Rio Pilão near Santos, São Paulo.

Head 3.8-4.2; depth at origin of dorsal about equal to length of head; caudal peduncle 6.5-6.8 in length, 1.6-1.7 in head. Eye equal to narrowest width of interorbital and 2.6-3 in head. Profile highly arched or humped. Head depressed and broad.

D. 7; A. 8-9; P. 10; V. 6; scales 27-29 in lateral line; 7 in transverse series.

Origin of dorsal over last rays of anal. In females the distance from the tip of the snout to the origin of the dorsal about equals that from the origin of the anal to the middle, or end, of the caudal. Ventrals lanceolate, middle rays longest, barely reaching the vent.

In males the ventrals arise on a prominence directly under the pectorals. They are greatly produced, bear processes near their tips and are about as long as the head. The anal is about 1.5 as long as the head.

The fins are without color. A single male from Barreiras has the lower portion of the dorsal heavily pigmented and an oblong spot at the base of the caudal. The posterior dorsal rays are not produced.

A female from Rio Pilão, 42 mm. in total length, contained twenty-four embryos, curled, but seemingly ready for expulsion.



Color in spirits, golden yellow. Margins of scales outlined with darker. A conspicuous dark zig-zag line of chocolate pigment is formed by the heavily pigmented upper margins of the scales in the sixth lateral series, counting ventrally and transversely from the dorsal. Then ext series of scales below forms a clear streak without pigment. The keel of the caudal peduncle is also slightly pigmented.

Named for Dr. W. J. Holland, whose interest and support has made possible the extensive collections of South American fishes in the Museum of which he is Director.

#### Genus FITZROYIA Günther.

*Fitzroyia* GÜNTHER, Cat. Fishes Brit. Mus., VI, 1866, pp. 299, 307 (*multidentata*).

*Jenynsia* GÜNTHER, *ibid.*, VI, 1866, pp. 300, 331 (*lineata*).

Type of genus by monotypy *Lebias multidentata* Jenyns = *Lebias lineata* Jenyns.

The dentition consists of an outer series of compressed, slightly recurved, tricuspid incisors, immediately behind these a band of much smaller tricuspid teeth. Intestine about equal to, or less than, the length of the fish.

Anal fin of the male modified to form a tube. Anal rays separate, but enclosed in a loose sheath, forming the tube. The tip of this organ, as pointed out by Garman, turns either to the right or left, the males are thus rights and lefts. The genital orifice of the female is symmetrical. This fact seems to indicate that the male dextrality and sinistrality, at least in this genus, has no especial significance.

The male organ of this genus is much simpler than in *Anableps*. In *Anableps* the anal rays are indeterminable, are heavily ensheathed in fleshy pads and are scaled. The anal tubular structure may thus have arisen independently in the two genera.

Several young males of *F. maculata* show the development of the tube. An epidermal flap appears, surrounding the foremost anal rays, and eventually enclosing all of them. The anal tube of adult males is about equal to the length of the head.

Body slightly depressed; snout short and blunt; cleft horizontal; lower jaw not extending beyond upper.

#### KEY TO THE SPECIES OF FITZROYIA.

- a. Scales less than eighteen between occiput and dorsal.
  - b. Origin of dorsal slightly in advance of anal.
    - c. Lateral line 29-30, a series of regular, longitudinal lines on the flank.
      32. *lineata* (Jenyns).

- cc. Lateral line 32-33, no lines or dots, large irregular blotches, ventral half of body darker. . . . . 33. *eigenmanni* Haseman.  
 bb. Origin of dorsal about opposite anal. A series of longitudinal rows of oblong spots. . . . . 34. *maculata* (Regan).  
 aa. Scales more than 18 between occiput and dorsal. Lateral line 32-35. 35. *pygogramma* (Boulenger).

### 34. *Fitzroyia lineata* (Jenyns).

- Lebias lineata* JENYNS, Beagle Zoöl., Fishes, 1842, p. 116, pl. 22, fig. 2.  
*Lebias multidentata* JENYNS, *ibid.*, 1842, p. 117, pl. 22, fig. 3.  
*Fitzroyia multidentata* GÜNTHER, Cat. Fishes Brit. Mus., VI, 1866, p. 307.  
*Jenynsia lineata* GÜNTHER, *ibid.*, 1866, p. 331; GARMAN, The Cyprinodonts, Mem. Mus. Comp. Zoöl., XIX, 1895, p. 69, pl. VIII, fig. 2-3; VON IHERING, Süßwasserf. v. Rio Grande do Sul, 1893, p. 28; LAHILLE, Revista Mus. de la Plata, VI, 1895, p. 275 (Arroyo del Gato); BOULENGER, Boll. Mus. Torino., X, No. 279, 1897, p. 4; REGAN, Ann. Mag. Nat. Hist., (8), XI, 1913, p. 232.  
*Jenynsia multidentata* BOULENGER, Boll. Mus. Torino, X, 1897, p. 4 (Lesser, Tala.).  
*Fitzroyia lineata* BERG, Ann. Mus. Nac. Buenos Aires, V, 1897, p. 291.  
*Fitzroyia lineata* EIGENMANN, Proc. U. S. Nat. Mus., XXXII, 1907, p. 430; Repts. Princeton Univ. Exp. Patagonia, III, 1910, p. 457.

4670, C. M., seven, one male, six females, 44-66 mm. Rio Guahyba at Porto Alegre, Rio Grande do Sul.

Range: La Plata to Rio Grande do Sul.

Head 4-4.3; depth at origin of dorsal 4-4.5, depth of caudal peduncle 7 in length to base of caudal and 1.8 in head. Eye 3 in head, equal to interorbital. Snout 1.3 in eye.

D. 8-9; A. 8; P. 14; V. 6; scales 14 between occipital and dorsal; 29-30 in lateral series; 8 in transverse series.

Origin of dorsal slightly in advance of middle of the total length; anterior to origin of anal in both sexes.

General form elongate. Pectorals large and round, caudal subtruncate. All fins usually without color.

A series of from four to six continuous horizontal lines, formed by contiguous marks on overlapping scales.

The largest specimen, a female in the I. U. M., is 69 mm. long. Of the males, which range from 25-45 mm. in length seven have the anal tube of the male turned to the right and fifteen to the left.

### 35. *Fitzroyia eigenmanni* Haseman.

- Fitzroya eigenmanni* HASEMAN, Ann. Carnegie Museum, VII, 1911, p. 385, pl. LXXXII.  
*Jenynsia eigenmanni* REGAN, Ann. Mag. Nat. Hist., (8), XI, 1913, p. 233.

2866, C. M., one, the **type**, 43 mm. 2867, C. M., thirteen, **paratypes**, 17-45 mm. Rio Iguassú system, near Serrinha Paraná, Brazil. Haseman.

Head 4-4.5; depth at origin of dorsal about equal to head; depth of caudal peduncle 7.6-7.8 in length to base of caudal and 2 in head. Eye 3.3 in head. Interorbital 1.5 in eye.

D. 8-9; A. 7-9; P. 14; V. 6; scales 16-17 between occipital and dorsal; 32-33 in lateral line; 8-9 in transverse series. The posterior 18-21 scales in the lateral series have a conspicuous central pit, or pore, the only approach to the usual lateral line pores, I have seen in any Pæciliid.

The dentition is composed of an outer series of compressed tricuspid, an inner series partly of smaller tricuspid and partly of spike-like incisors.

This species differs from the other members of the genus in being more elongate and more compressed. It differs also in coloration.

A broad, horizontal, purplish lateral band formed by continuous blotches. In young specimens this is a narrow broken line. Ventral half of body darker. Belly prominent, yellowish in color. Fins without color, caudal truncate.

### 36. *Fitzroyia maculata* (Regan).

*Jenynsia maculata* REGAN, Ann. Mag. Nat. Hist., (7), XVIII, 1906, p. 154 (Cachi, Salta, Argentina); *ibid.*, (8), XI, 1913, p. 233.

4667, C. M. Eleven, five males, 20-31 mm., six females, 20-52 mm.

Arroyo Miguelete, Montevideo. Haseman.

4668, C. M. Twenty, 13-20 mm. Monté, Argentina. Haseman.

4669, C. M. Fifteen, three males, nine females, three young. 11-55 mm. Near Colorado, Rio Colorado, Argentina. Haseman.

Range: Uruguay and Argentina.

Head 3.4-4; depth at origin of dorsal 4-4.5; depth of caudal peduncle 6.5-7 in length to base of caudal and 1.8-2 in head. Eye prominent, 3.4-4 in head; about equal to interorbital. Interocular width about 2.4 in head.

D. 8-9; A. 9-10; P. 14; V. 6; scales 12 between occipital and dorsal; 28-30 in lateral line; 8 in transverse series.

Origin of dorsal about opposite that of anal, sometimes slightly anterior. In males the anal is sometimes slightly in advance of the dorsal. Fins without color; pectoral large and round, caudal subtruncate or slightly rounded.

Closely related to *F. lineata*, from which it differs in having the continuous lines broken up into a series of large oblong spots.

A female (48 mm.) taken at Colorado on March 6, 1909, contained forty-eight embryos, averaging in length about 9 mm. They are straightened out and are evidently almost ready for expulsion. A large number of chromatophores are present and the lateral line is well-marked by a conspicuous row of these.

### 37. *Fitzroyia pygogramma* (Boulenger).

*Jenynsia pygogramma* BOULENGER, Ann. Mag. Nat. Hist., (7), IX, 1902, p. 336 (Cordova, Río Cruz del Eje, Argentina); REGAN, *ibid.* (8), vol. XI, 1913, p. 233. *Fitzroya pyrogramma* EIGENMANN, Repts. Princeton Univ. Exp. Patagonia, III, 1910, p. 457.

No specimens were secured by Mr. Haseman. "D. 8-9; A. 9-10; L. lat. 32-35." This species appears to differ from *F. lineata* in the smaller scales "18 to 25 transverse series between the occiput and the dorsal fin" and in coloration. "Golden yellow above, speckled and spotted with black, white beneath . . . distinct black lateral streak . . . female with a large V-shaped, purplish-black marking, edged with orange, on the belly, the point on the vent."

I have examined one of the paratypes, received from Rosenberg. It most resembles *F. eigenmanni* in coloration, but differs in the numerous series of small predorsal scales.

### Genus ANABLEPS Artedi.

*Anableps* ARTEDI, Gen. Pisc., 1738, p. 25.

### 38. *Anableps anableps* Linnæus.

*Anableps anableps* LINNÆUS, Syst. Nat., Ed. 9, 1756, p. 55; GARMAN, Mem. Mus. Comp. Zoöl., Vol. XIX, 1895, p. 77.

4618, C. M., one, 178 mm., Río Caeté, Pará. Haseman.

4619, C. M., one, 98 mm., Pará. Haseman.

### 39. *Anableps microlepis* Müller and Troschel.

*Anableps microlepis* MÜLLER & TROSCHER, Monatsb. Akad. Berlin, 1844, p. 36; GARMAN, Mem. Mus. Comp. Zoöl., Vol. XIX, 1895, p. 78.

4620, C. M., two, 125-143 mm. Río Caeté, Pará. Haseman.

4621, C. M., two, 94-108 mm. Belem, Pará. Haseman.

4622, C. M., two, 52-190 mm. Pará. Haseman.